Minutes from the Kangaroo Island dunnart workshop

Monday 27 May 2019, Ozone Hotel, Kangaroo Island

In attendance

Rosemary Hohnen (National Environmental Science Program (NESP) Threatened Species Recovery Hub (TSRH)), Jasper Taylor (Kangaroo Island (KI) Natural Resources Management (NRM) Board), John Woinarski (NESP TSRH), Sarah Legge (NESP TSRH), Chris Dickman (NESP TSRH), Oliver Tester (Department of Environment and Energy, Australian Government (DoEE)), Leonie Brettell (DoEE), Emma Graham (DoEE), Dan Rogers (Department for Environment and Water Government of SA (DEW)), Peter Copley (DEW), Jody Gates (DEW), Jennie Fluin (DEW), Jason Higham (DEW), Matt Heard (DEW), Robyn Molsher (DEW), Damon Ezis (DEW), Damian Miley (Natural Resources KI, DEW (NRKI)), Mike Grieg (NRKI), Phillipa Holden (NRKI), Brett Dalzell (NRKI), Venetia Bolwell (NRKI), Karleah Berris (NRKI), Brenton Florance (NRKI), Josh Mulvaney (NRKI), Paul Jennings (NRKI), Danny Male (NRKI), Ross Evans (NRKI), Rebecca Mussared (NRKI), Sharon Gullickson (NRKI), Anne McLean (NRKI), Tony Sandeman (NRKI), Katherine Tuft (Arid Recovery), Hugh McGregor (Arid Recovery), Pat Hodgens (Kangaroo Island Land for Wildlife (KI LfW), Heidi Groffen (KI LfW), James Doube (KI landholder), Peter Hammond (KI landholder), Nirbeeja Saraswati (KI landholder), Tony Robinson (KI landholder), Julia Haska (KI landholder), John Hodgson (KI landholder), Pip Masters (Envisage Environmental Solutions (EES)) and Rick Southgate (EES).

Apologies

Sally Box (Threatened Species Commissioner, Australian Government), Fiona Fraser (DoEE), Peter Latch (DoEE), Brett Murphy (Charles Darwin University TSRH) and Trish Mooney (NRKI).

Introduction and welcome

Dan Rogers welcomed all participants to the meeting and outlined the aim of the workshop: to discuss the information known about the Kangaroo Island dunnart and the threats to it, and use this to develop a Conservation Advice under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) for the species.

Jasper Taylor welcomed all participants to Kangaroo Island and thanked everyone for travelling across Australia to KI for the workshop.

John Woinarski explained the National Environment Species Program (NESP) is a research consortium that works in partnership with the Australian Government to assist threatened species. The NESP has a suite of research programs investigating how to manage the impacts of feral cats on threatened species across Australia. The purpose of this workshop is also for Dr Rosemary Hohnen to report on her research on the KI dunnart, to assist KI land managers to conserve the species, and to assist with the development of the Conservation Advice.

Contents

1. Status and trend 3

1.1 Status and recovery of the KI Dunnart: What do we know? 3

1.2 Detecting and monitoring the KI dunnart 7

1.3 KI dunnart monitoring on private land 14

1.4 Discussion of status, trend and monitoring of KI dunnarts 17

1.5 Summary 20

2. Threats 21

2.1 Feral cat densities on Kangaroo Island 21

2.2 Fire and the KI dunnart 25

2.3 Fire planning around ecology on KI 30

2.4 Discussion of additional threats 34

3. Conservation actions 37

3.1 Feasibility of broadscale feral cat baiting on western KI 37

3.2 Update from the KI Cat Management Program 42

3.3 Private land management for dunnarts 45

3.4 Discussion of management objectives and actions 48

4. Summary, final comments and next steps 50

Image above: Dr Rosemary Hohnen presenting her research during the workshop.

Funding

This workshop was supported by the KI NRM Board through funding from the Australian Government's National Landcare Program.

1. Status and trend

1.1 Status and recovery of the KI Dunnart: What do we know?

(Jody Gates, Department for Environment and Water Government of SA)

Historical/incidental records – pre 1999

- A small number of records from late 60s onwards:
  - » early reports from landholders: when clearing vegetation KI dunnarts ran out of yackas
- SA Biological Survey (1990): one record in Flinders Chase
- Nature Conservation Society Survey (1996): ? sites, zero detections
- Ranger surveys (mid-90s): several records: sites along West End Highway
  - » all KI dunnarts trapped in a small area in Flinders Chase National Park despite widespread trapping across KI using pitfall traps
  - » radio tracking gave information on where KI dunnarts roost.

1999-2010

- Threatened Species Program (1999-2001): 46 sites, 22 KI dunnarts captured at six sites
- KI staff surveys (~2009): detected KI dunnarts at two sites (of the six above) and incidentally at three new locations.

2010-present

NESP

- 35 sites (sampled in spring) and 42 sites (sampled in autumn)
- detected on seven occasions at five sites
- one previously occupied site, four new locations.

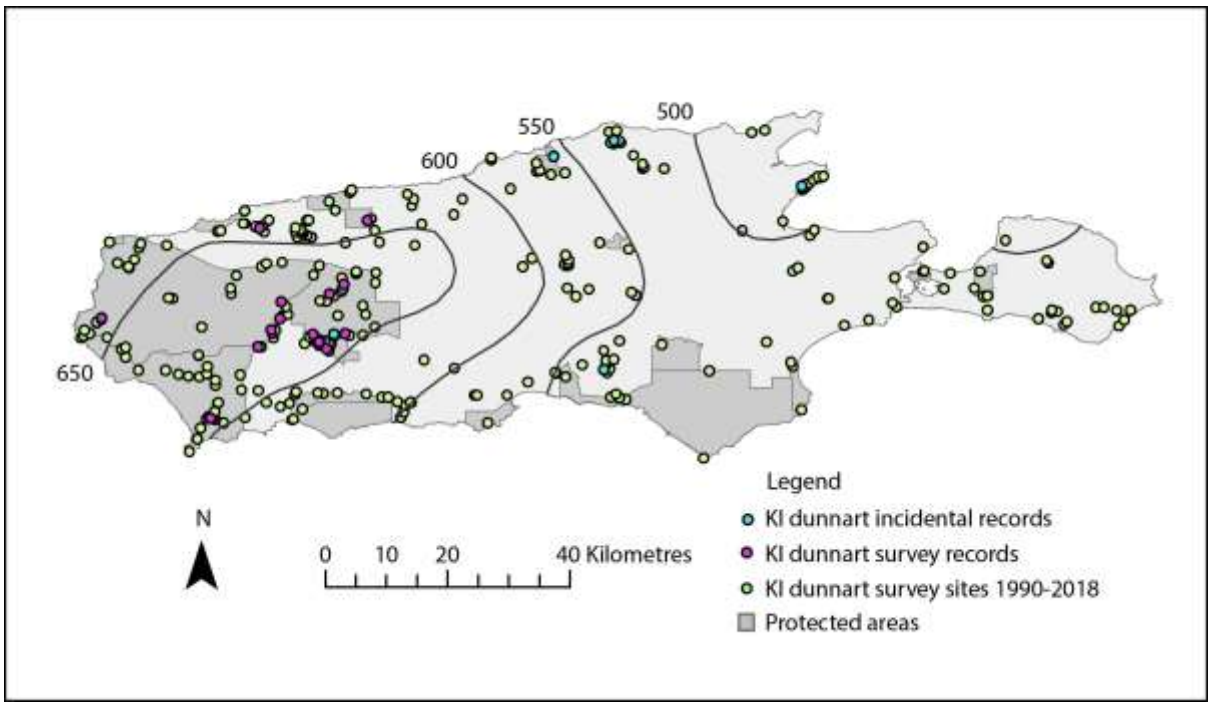
Land for Wildlife:

- camera trapping on private properties
- 50 sites surveyed on 16 properties
- five confirmed detections.

The large survey effort has not revealed much information about the KI dunnart to date.

Due to the rarity of the KI dunnart, little is known about its preferred habitat, life cycle and breeding.

Figure 1. Habitat preferences of the KI dunnart (Hohnen *et al.*, in preparation)

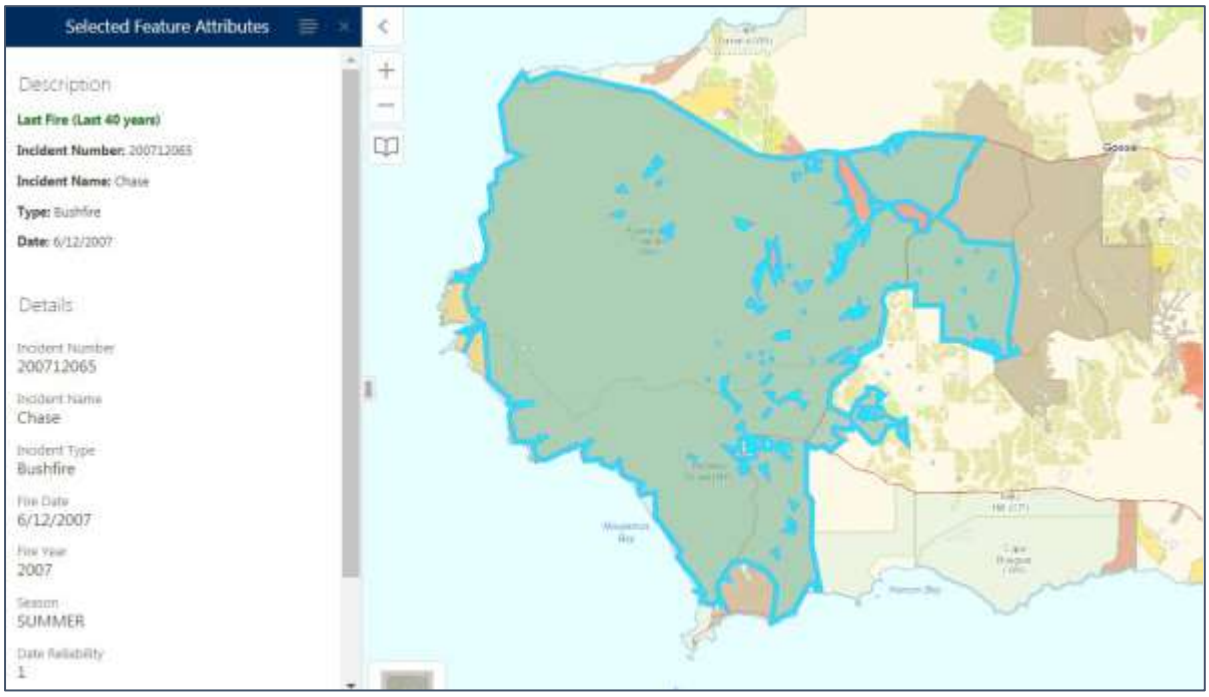


Progress of Recovery Actions

(Recovery plan drafted 2002 and finalised and released 2011).

1. Clearly define and map the known KI dunnart population sites.
2. Complete a management plan to document specific management prescriptions for protecting known KI dunnart sites.
3. Continue to implement standard Phytophthora hygiene practices when undertaking all fieldwork activities.
4. Reduce the likelihood of contiguous remnants of significant dunnart habitat burning in their entirety during a single fire event.
5. Reduce the likelihood of fire suppression activities including prescribed burning and fire suppression, impacting upon the long term viability of KI dunnart populations.

Figure 2. Extent of 2007 bushfire



The impact of the 2007 wildfires in Flinders Chase National Park to wildlife/biodiversity, including the KI dunnart, are largely unknown.

6. Dunnart habitat is maintained by implementing appropriate fire regimes across known habitat areas.
7. Improve knowledge of how KI dunnart populations respond to fire, by filling in knowledge gaps.
8. Continue to trial different capture and detection methods to maximise capture rates of KI dunnarts.
9. Clarify the influence of habitat type and patch size on the distribution of the KI dunnart.
10. Radio-track all dunnarts captured under Action 3.1 to obtain more information on home range sizes, movements and record details of shelter sites.
11. Undertake a mark and recapture pitfall trapping program at the major known site with dunnarts and record details of all dunnarts captured to determine sex ratios, longevity of individuals and population dynamics.
12. Document breeding condition of all dunnarts captured through Action 3.1.
13. Investigate and determine the impact of Phytophthora on the distribution of KI dunnarts.
14. Investigate the potential threat of predation and/or spread of toxoplasmosis by feral cats and implement threat abatement strategies as necessary.
15. Undertake an assessment of the need to establish a captive colony.
16. Seek the involvement of suitable personnel and establish a Recovery Team.
17. Hold Recovery Team meetings as necessary, and at least annually, to assess the progress towards performance criteria.

Figure 3. KI dunnart survey sites (Hohnen *et al*, 2018)

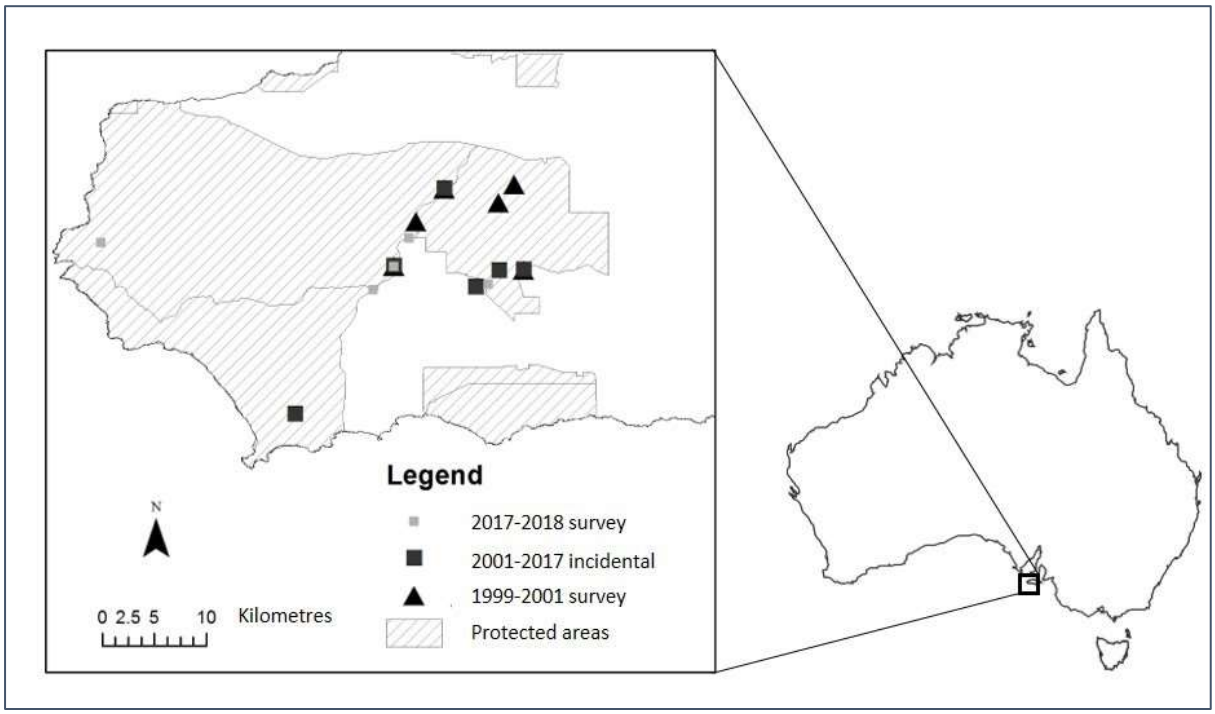
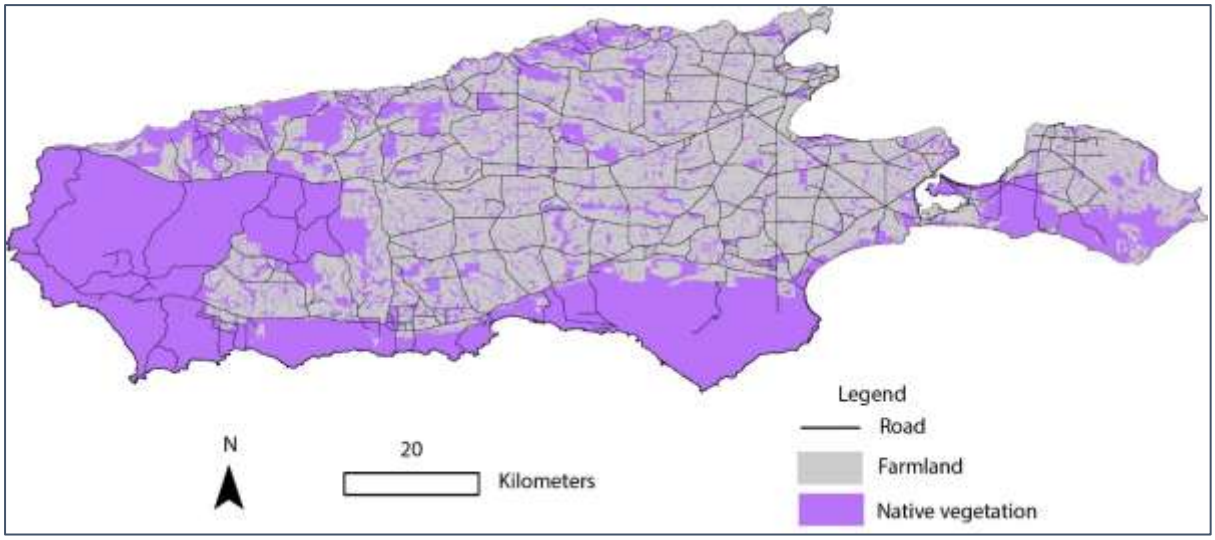


Figure 4. Native vegetation on Kangaroo Island (Hohnen *et al.*, in preparation)



1.2 Detecting and monitoring the KI dunnart

(Dr Rosemary Hohnen, National Environmental Science Program)

Detecting and protecting the KI dunnart

Endangered and protected by the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) and *SA National Parks and Wildlife Act* 1997.

Figure 5. KI dunnart survey locations

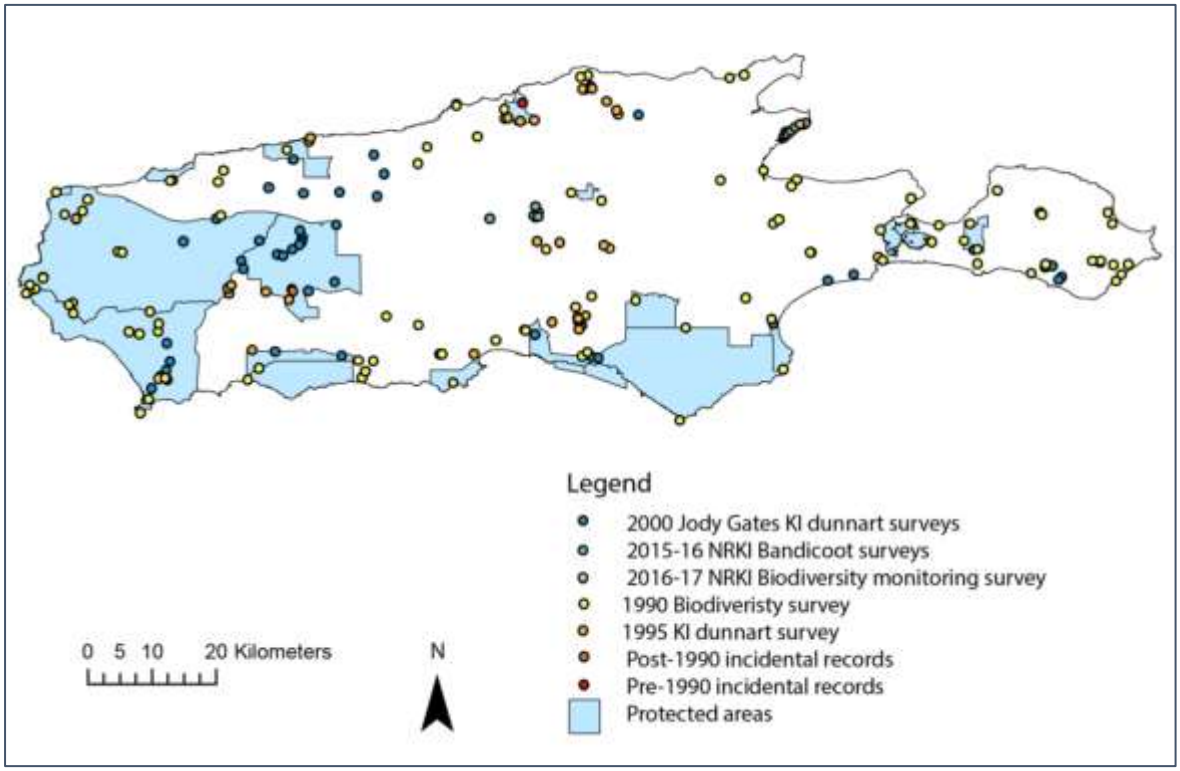
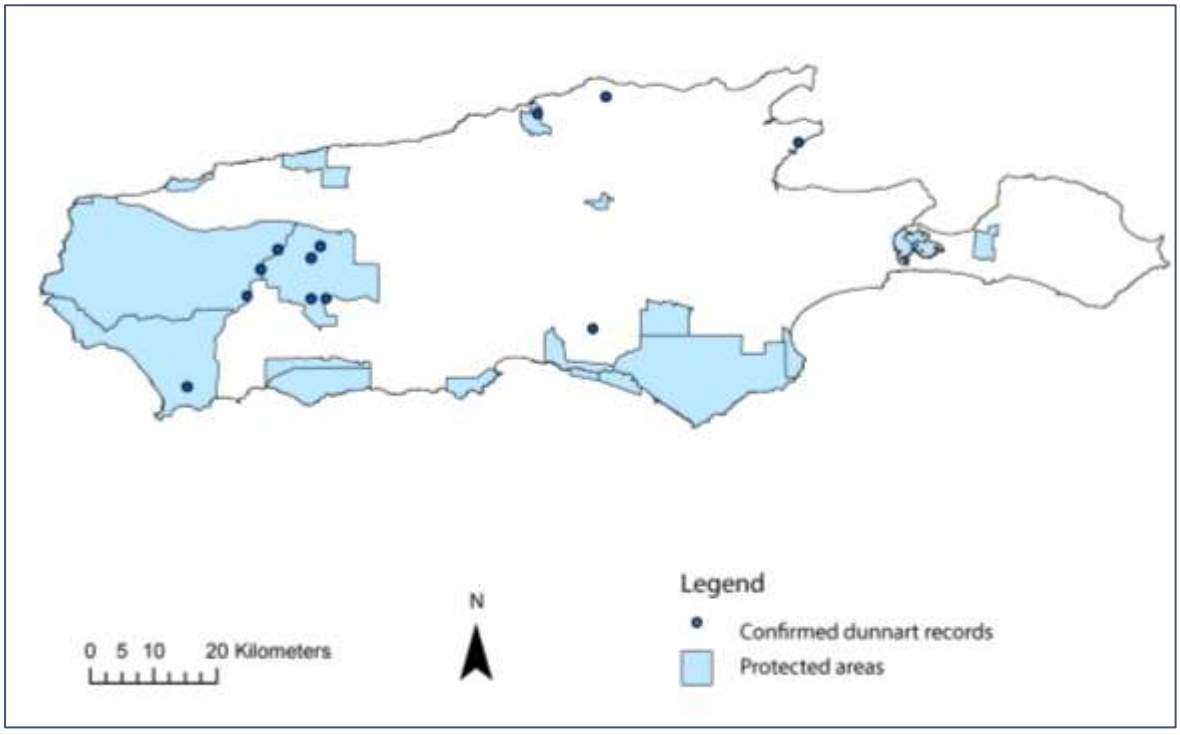


Figure 6. Confirmed KI dunnart records



Research questions

1. What is status of the KI dunnart?
2. What is the most effective method of detecting the KI dunnart?
3. What is the best means of monitoring the species?
   - 3.1 Detection method
   - 3.2 Time of year
   - 3.3 Number of sites surveyed

1. What is status of the KI dunnart?

- There are very few records of the KI dunnart prior to 2016.
- A KI dunnart has not been found on the Dudley Peninsula for 30 years.

2. What is the most effective method of detecting the KI dunnart?

Four methods were tested to detect KI dunnarts across a range of fire categories and vegetation dominated by three different overstorey species at 42 sites (see Figure 7):

1. Elliot traps
2. pitfall traps with a drift fence line – three different sized pitfall traps were trialled
3. camera traps
4. baited camera traps.

Figure 7. KI dunnart trapping

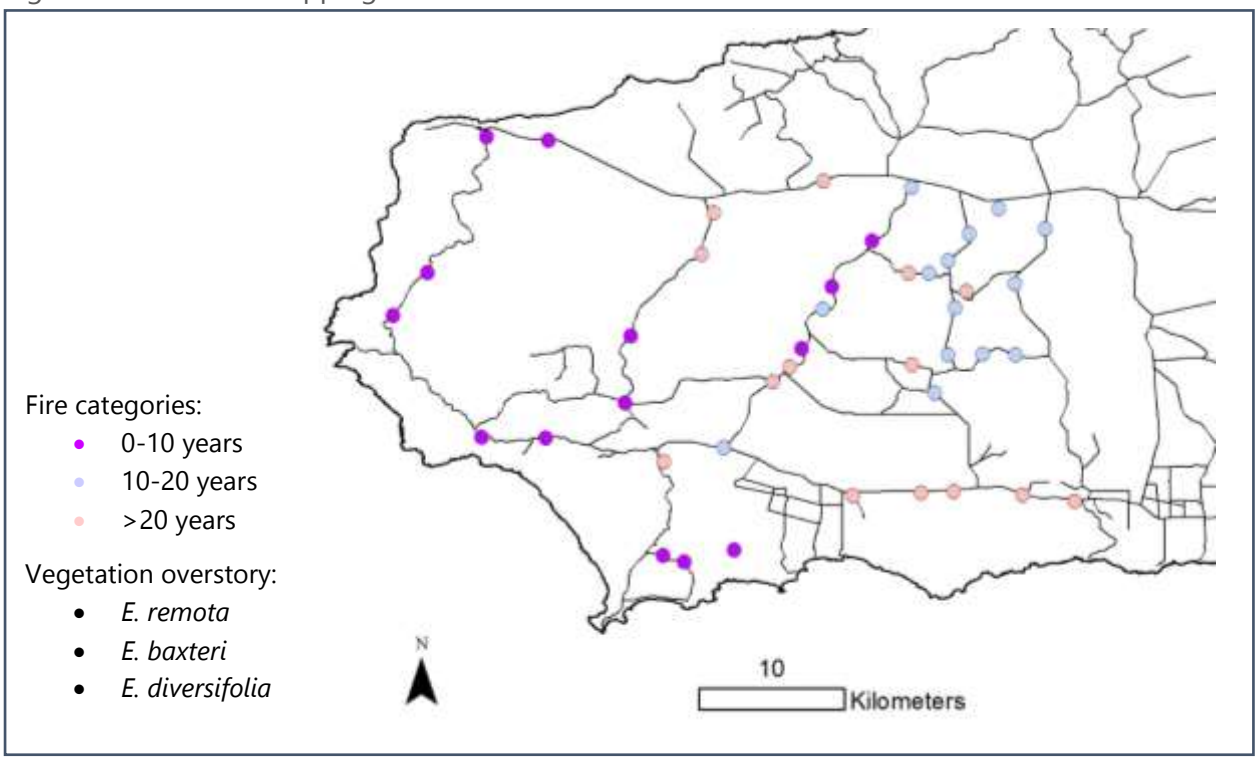
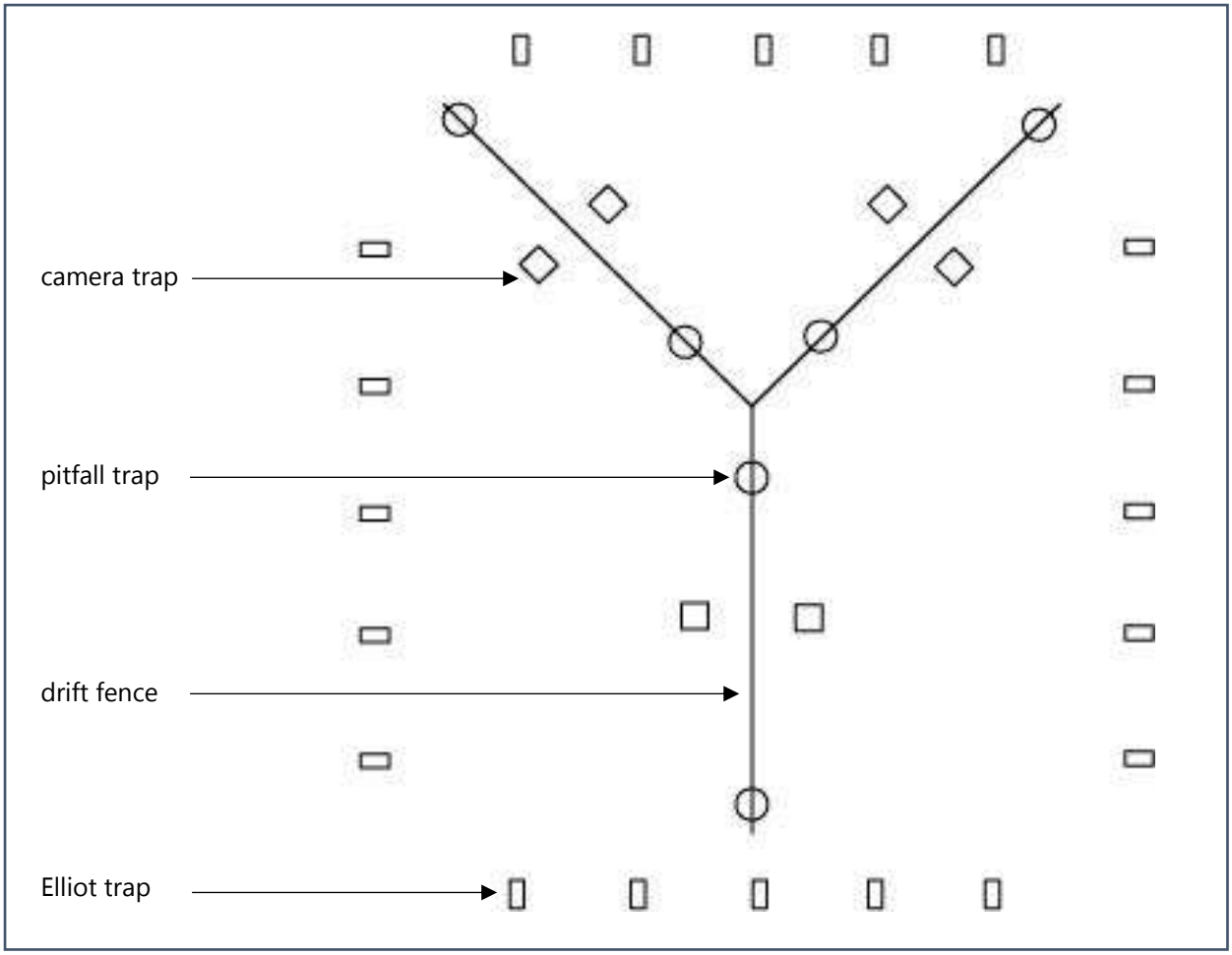


Figure 8. Four detection methods



Each site was trapped for three nights using the grid above (see Figure 8). After three nights the pitfall and Elliot traps were removed and the cameras were left for a further 10 nights.

Results:

KI dunnarts were detected at six sites by cameras: three were photographed on the fence line and three on baited cameras (see Figure 9).

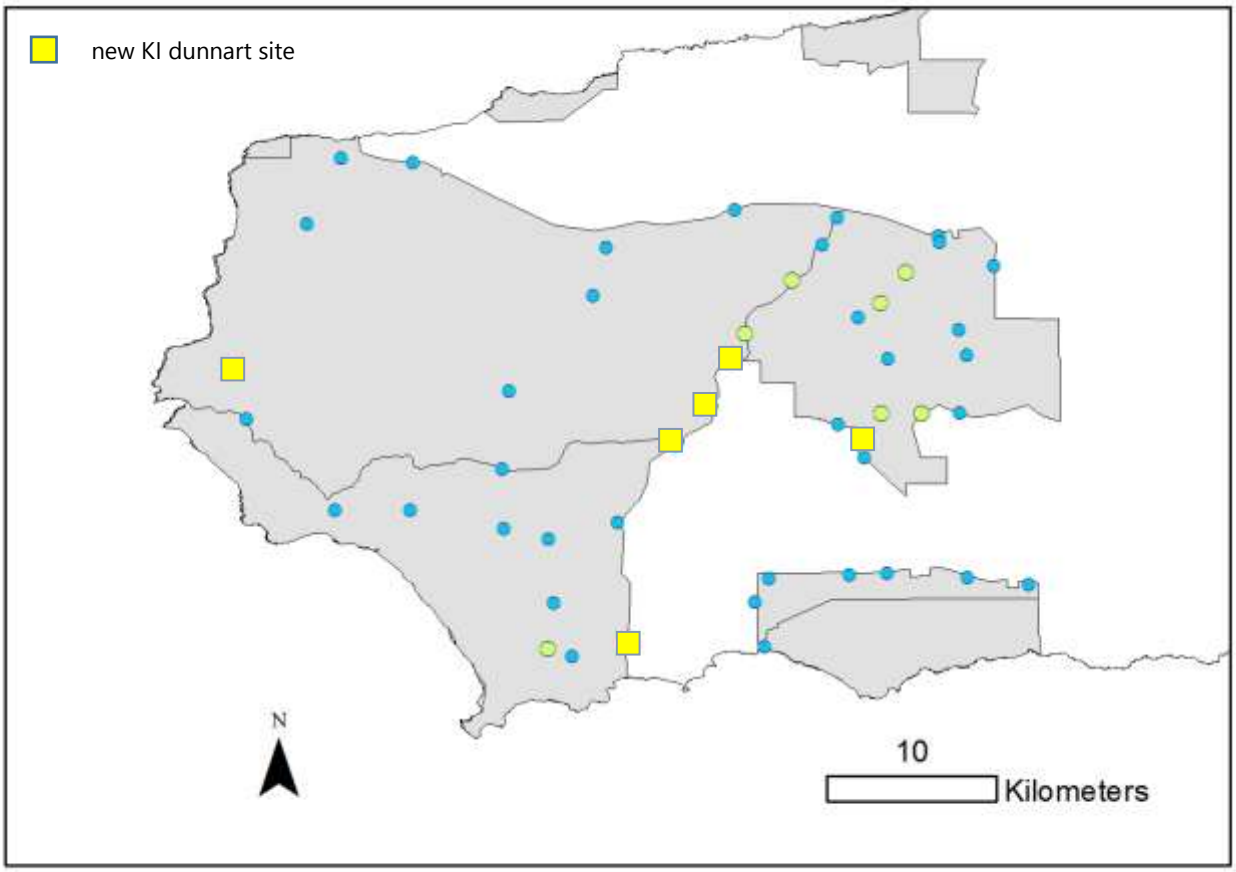
Why so few captures?

Table 1. Methods used to detect KI dunnarts 1999-2018

Survey period	Detection method	Pitfall trap nights	Captures	Trap success (captures per 1000 nights)
1999–2001	Pitfall	13,714	21	1.5
1999–2001	Elliott	8,941	1	0.1
2017–18	Pitfall	1,386	0	0.0
2017–18	Elliott	4,620	0	0.0
2017–18	Fence line camera traps	2,268	4	1.8
2017–18	Baited camera traps	3,171	2	0.6

A large trapping effort is required to detect KI dunnarts.

Figure 9. New KI dunnart records



3. What is the best means of monitoring the species?

3.1 Detection method

- Remote cameras used in conjunction with a pitfall trap fence was the most successful detection method for KI dunnarts and also the most cost-effective method.
- Baited camera traps also detect KI dunnarts well, but they attract a large number of non-target species compared with the drift fence camera trapping.

Figure 10. Detection probability of fence line cameras

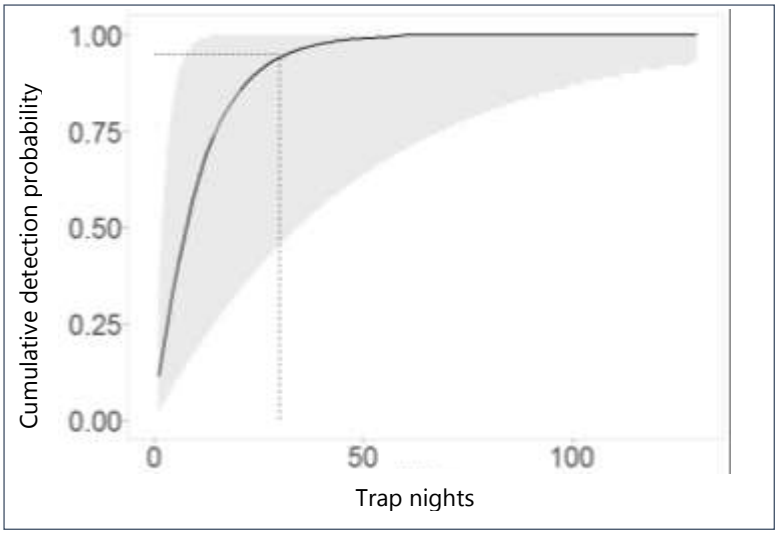


Figure 11. Detection probability of baited cameras

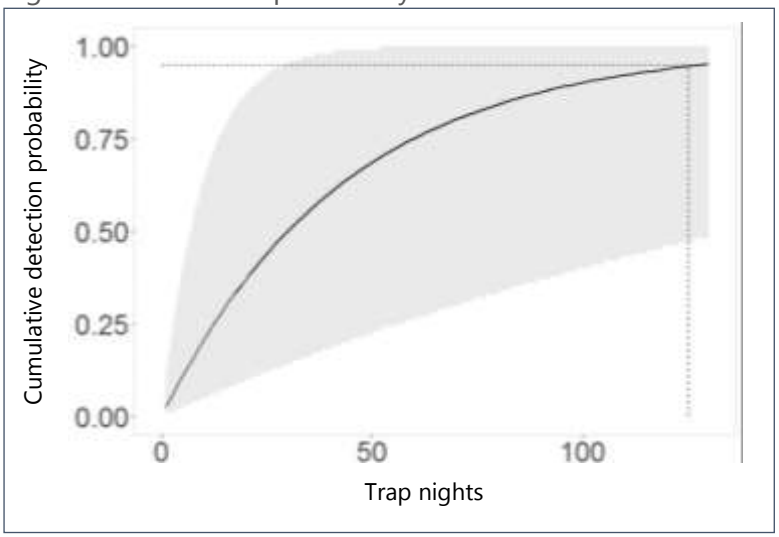


Figure 12. Detection probability of pitfall traps (1999-2001)

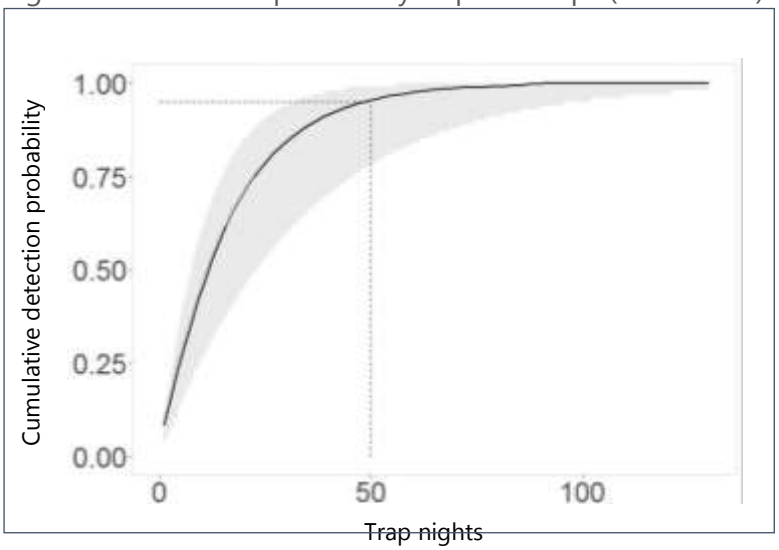
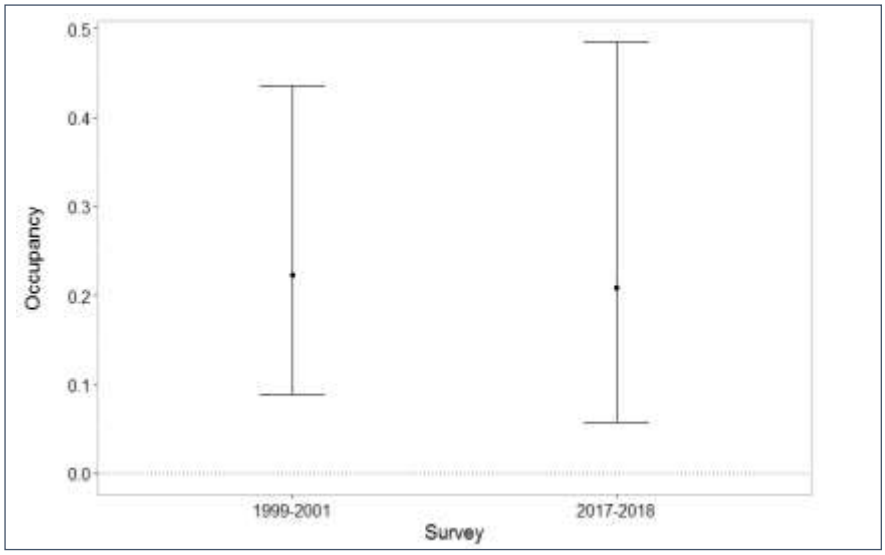


Figure 13. Change in occupancy 1999-2018



- The KI dunnart is restricted to:
  - » 27% of sites in *Eucalypt* woodland on western KI, which indicates low numbers of KI dunnarts in a limited area
  - » 8% of KI total area (352 km^2).
- The occupancy modelling suggests there may be changes in occupancy of the KI dunnart, however, because of low detection numbers, it is hard to determine if there has been a decline in the KI dunnart population over the last 20 years.
  - » The results highlight the need for a monitoring program to determine any trend in the status of the KI dunnart.

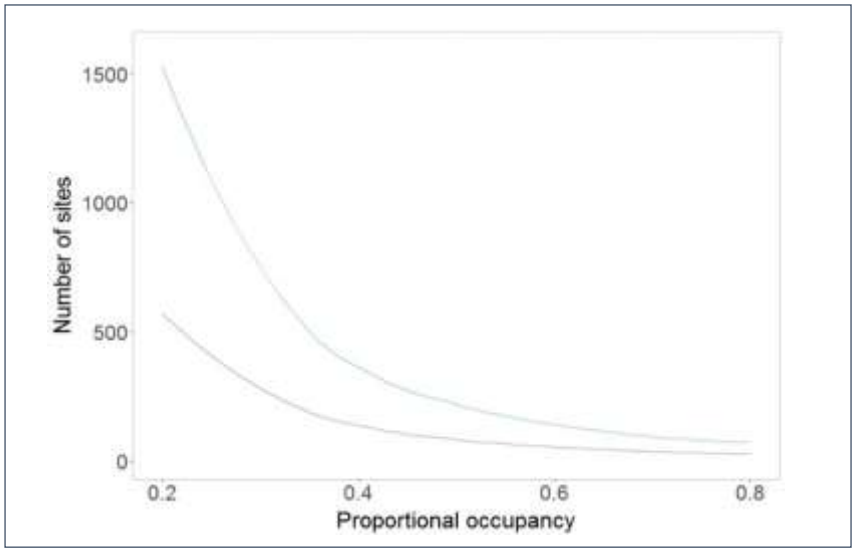
3.2 Time of year

Trapping was undertaken between August and September.

3.3 Number of sites surveyed

Nightly detection was modelled and showed for a 95% chance of detecting a KI dunnart, trapping must be conducted for 31 nights.

Figure 14. Detection rates for KI dunnart



Monitoring program recommendations

- Use camera traps on fencelines
  - » sensitive
  - » cost-effective.
- Survey in spring/summer
- Trend monitoring:
  - » to measure a 60% decline need to survey for KI dunnarts at 55 sites
  - » to measure a 80% decline need to survey for KI dunnarts at 26 sites.

Outcomes

- KI dunnart restricted to:
  - » 8% of KI total area (352 km^2)
  - » likely at low densities.
- Most effective method:
  - » Camera traps on fencelines.
- Most effective time of year:
  - » Spring/summer.
- Number of sites:
  - » 26 sites to detect an 80% decline
  - » 55 sites to detect a 60% decline.

1.3 KI dunnart monitoring on private land

(Pat Hodgens and Heidi Groffen, Kangaroo Island Land for Wildlife)

The group Kangaroo Island Land for Wildlife Association (KI LfW) began 18 months ago. This voluntary, biodiversity conservation association of landholders aims to provide safe havens for plants and animals, and improve habitat by removing key threats to plants and animals.

For the past twelve months Pat and Heidi have assisted KI LfW members to monitor for the presence or absence of fauna species using Swift Enduro cameras with an aluminium mesh drift fence, at 58 sites on 20 private properties, predominantly on western Kangaroo Island.

- This monitoring has detected the presence of the KI dunnart forty times at five sites. KI LfW has not detected the KI dunnart at any of their survey sites on eastern Kangaroo Island to date (see Figure 15).
  - » Four of the sites where the KI dunnart has been photographed are within long unburnt habitat and one site is within an area burnt in 2007.
  - » Different sized KI dunnarts have been photographed prompting KI LfW to believe they have recorded animals from different age classes.
  - » Most of the KI dunnarts were photographed between 8 pm and 7 am.
- More KI dunnarts have been photographed in spring and summer than in winter and autumn (see Figure 16).
- Monitoring sites have been selected in open mallee and low woodland vegetation within a mix of long unburnt and recently burnt sites. Each site has been connected to another area of native vegetation via a corridor.
- The cameras detect motion and heat and are checked every three weeks.
- The cameras have also detected the presence of other threatened species such as the southern brown bandicoot 19 times, heath goanna, KI echidna and bassian thrush.

Figure 15. Sites where KI dunnarts have been detected by KI LfW

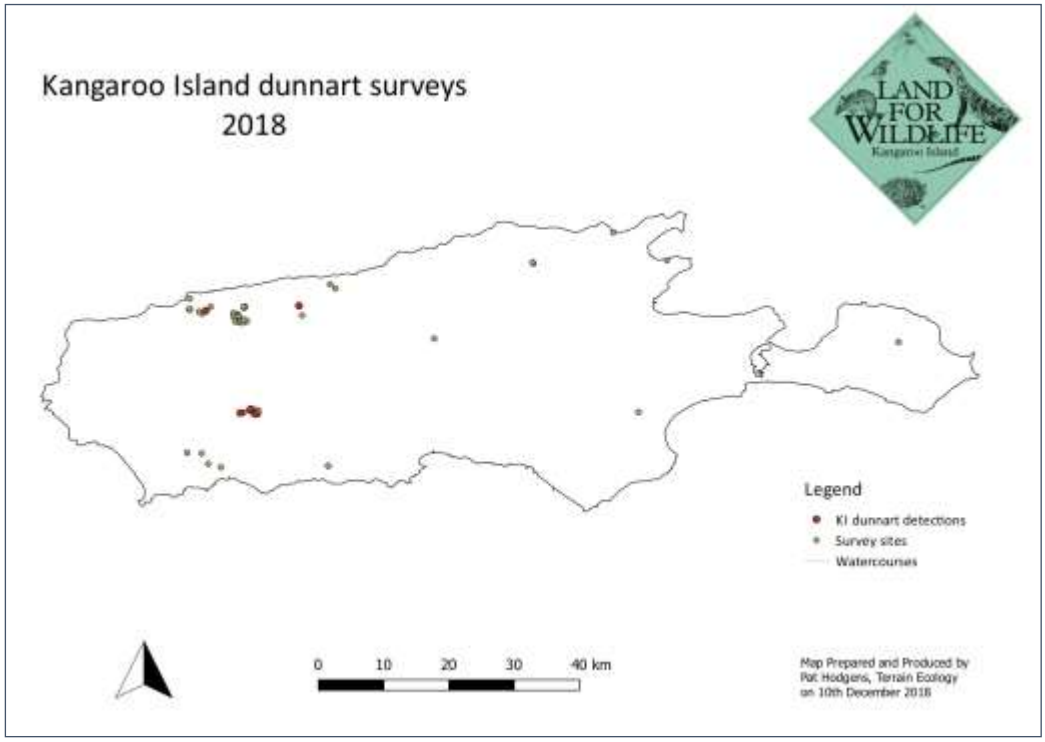


Figure 16. Seasonal detections of KI dunnarts by KI LfW

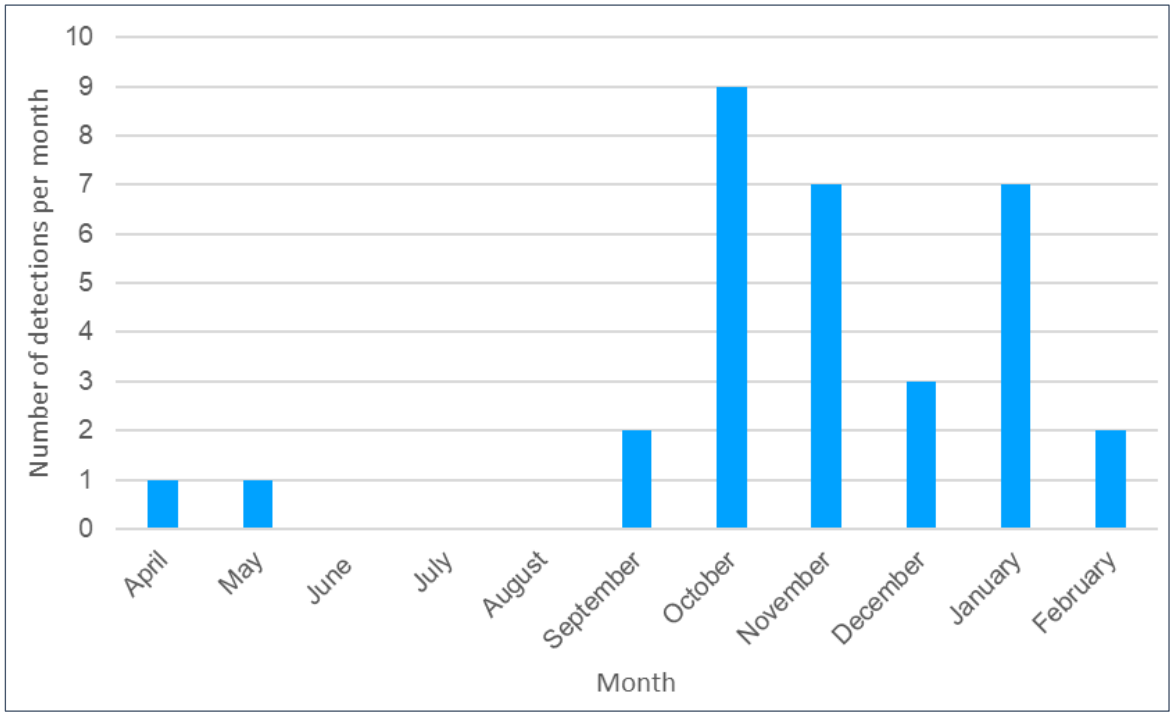
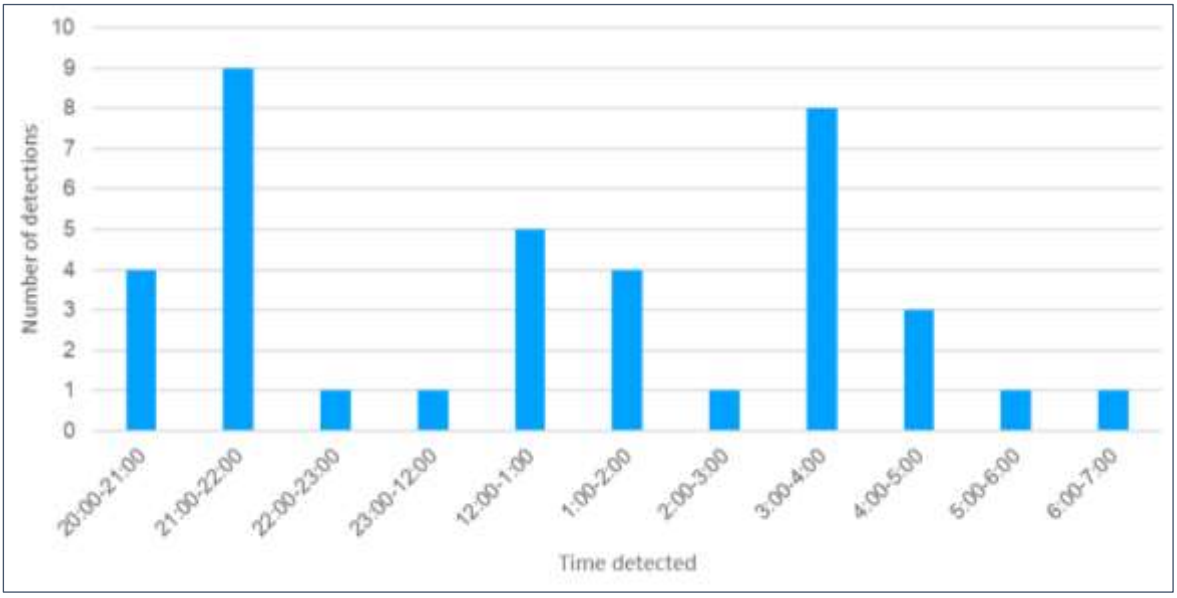


Figure 17. KI dunnart detections between 8 pm and 7 am



KI LfW have conducted incidental fauna surveys using active searches of scats and diggings. Song meters have been used to record bird calls and boobook owls have been detected.

Managing threats to KI dunnarts

Heidi and Pat have been assisting KI LfW landholders to control feral cats at sites where KI dunnarts have been detected. The stomach contents of controlled feral cats are being analysed. No KI dunnart remains have been found to date.

Many of the KI LfW sites appear to be effected by *Phytophthora cinnamomi* (Pc).

- Areas potentially effected by Pc are being mapped.
- KI LfW have recently purchased a Pc trailer for landholders to use to treat Pc and decrease its rate of spread.

KI LfW plan to assist landholders to undertake feral pig control in the future.

What is next for monitoring the KI dunnart on private land?

- Western and northern populations of known KI dunnarts will be protected from threats by 2021.
- Southern and eastern populations of KI dunnarts will be surveyed and protected from threats by 2021.
- A wild population of KI dunnarts will be protected within a feral free refuge/safe haven by 2021.

KI LfW have secured funding to employ two staff full time for the next two and a half years to assist landholders to undertake conservation activities.

1.4 Discussion of status, trend and monitoring of KI dunnarts

Question 1: Does the lack of captures of KI dunnarts in pitfall traps in recent surveys, compared with trapping undertaken before 2010, show a decline in the KI dunnart?

The lack of detection of KI dunnarts in pitfall traps may suggest a decline but it is very hard to say. The results are difficult to compare as:

- R Hohnen's pitfall trapping effort was 10% of J Gate's trapping effort.
- Remote cameras are a more effective method of detecting KI dunnarts.
- Only a very small number of KI dunnarts have been detected to date.

No KI dunnarts have been detected on eastern Kangaroo Island since the 1960s and this could indicate a population decline.

R Hohnen's results show the KI dunnart appears to currently only be present on 8% of Kangaroo Island, fitting within the criteria of an endangered species.

Question 2: Should there be a priority to find KI dunnarts on eastern Kangaroo Island?

Survey results from J Gates indicate KI dunnarts are restricted to western Kangaroo Island. However, based on other dunnarts species it seems unlikely that the KI dunnart is so specialised it could only occur on western Kangaroo Island and historical records indicate it was once more widespread across the island.

The first priority is to manage threats to the KI dunnart in areas on western Kangaroo Island where they have been recently found to ensure they persist into the future. The second priority is to try and detect them on eastern Kangaroo Island.

KI LfW plans to increase their activities cross eastern and northern Kangaroo Island over the next two years.

J Gates selected a wide range of sites for trapping across the Island. KI dunnarts were often only detected after the traps had been in place for more than 20 nights.

Question 3: Could the sites on eastern Kangaroo Island where KI dunnarts were previously found be re-surveyed?

It is too hard to determine the exact location of these sites to re-survey them, as many of these records were from incidental sightings.

Question 4: How many of J Gate's sites have the KI dunnart persisted in?

R Hohnen re-surveyed J Gates and R Molsher's sites on western Kangaroo Island and only found the KI dunnart at one of these sites.

- However, due to the lack of records and limited successful survey techniques, it is very hard to determine if they have persisted at other sites.
- The wildfires in 2007 burnt many of J Gate's sites, completely changing the habitat there.

T Robinson has surveyed for KI dunnarts on his property for 10 years using 39 pitfall traps at six sites and has only caught one KI dunnart at end of the 10 years.

- It appears that the distribution data for the KI dunnart exhibits a classic pattern found over many agricultural areas in Australia, where species have retreated from previously uncleared habitat to large, connected remnants containing sub-optimal habitat.

- However, due to the lack of detections it is very hard to analyse any trends statistically.

Question 5: Have any KI dunnarts been found in feral cat stomachs?
No KI dunnarts have been found yet.

Question 6: Would KI dunnarts have existed in a range of other habitats historically?
Other species of dunnarts use more generalised habitat and their distribution is often related to invertebrate density.

KI dunnarts may have lived in KI narrow-leaved mallee woodland prior to the clearance and fragmentation of this woodland.

- There may not be enough good quality KI narrow-leaved mallee woodland left for the KI dunnart to live in. If the quality was improved and predation pressure removed, they may be able to re-establish there.

Question 7: Many of the current surveys have been conducted close to roads. Would it be worth looking in areas away from roads? Could the distance from roadsides influence KI dunnart densities?
Survey sites close to roads are easier to establish as trapping equipment does not have to be carried so far. However, there may be more feral cats along roadsides due to roadkill which may impact on KI dunnart numbers.

One of the KI LfW sites which has recorded the most KI dunnarts is about one kilometre from the nearest road.

Question 8: Did J Gates catch any female KI dunnarts?
No

Question 9: Can other analogous species be used to determine the life history and demography of the KI dunnart?
The KI dunnart is too hard to detect to determine this yet.

Question 10: Could something be set up to measure the size and proportion of animals being photographed to detect their age class?
KI LfW believes they have photographed a young dunnart due to its small size and body shape.

A method to measure the scale of animals photographed has not been determined yet.

Question 11: Could males be dying off in winter?
Possibly.

Question 12: Is there other technology available to assist with KI dunnart detection?
New trackers have been developed that could be used to monitor KI dunnart movements in the future.

Question 13: Is the current distribution of Pc across KI known? What hygiene practise are being used to minimise the spread of Pc?

- Pc has not been mapped across KI since the early 2000s.

- KI LfW is currently mapping the extent of Pc on the private land owned by association members using drones and school students.

Question 14. What information do we have to monitor threats to the KI dunnart and their response to management actions?

R Hohnen's formula can be used to detect changes in KI dunnart populations. Monitoring will need to be undertaken using the most successful technique at the right time of year.

Question 15. Can other analogous species be used to detect changes to the KI dunnart and their response to management actions?

KI LfW have been detecting bandicoots at sites that have been recently burnt. They have not found KI dunnarts and southern brown bandicoots at the same sites.

R Hohnen has found southern brown bandicoots in native vegetation with a low, thick understorey (below the knee).

- Has only caught KI dunnarts and southern brown bandicoots together at two sites, therefore the southern brown bandicoot may not be a good indicator of the presence of KI dunnarts.

Question 16. Is there new technology that enables cameras to recognise animals and send the data through a mobile network?

- Not yet.
- Camera traps are a good tool to engage landholders with to improve their understanding of the species on their property.
- Cameras set along drift fences are not selective and record animals moving through the monitoring site.

Question 17. Are there differences between Reconyx and Swift remote cameras?

KI LfW have not tested differences between Reconyx and Swift cameras.

- They have been working with Outdoor Cameras Australia to change the focal length of Swift cameras to suit small mammal photography.
- They believe Swift cameras are much cheaper than Reconyx but that Reconyx cameras would be more durable.
- KI LfW believe their success with remote cameras is due to their experience using them and high number of trapping nights.

Question 18. How does KI dunnart detectability compare with other species?

The rate of dunnart detectability is generally much higher elsewhere in Australia than the rate for the KI dunnart. Detectability of the sooty dunnart (*Sminthopsis fuliginosus*) from WA may be up to ten times higher than the KI dunnart. A poor food supply may be keeping KI dunnart numbers down.

- T Robinson trapped for invertebrates on his property and found their numbers to be very low. Three times more invertebrates are found in arid lands.
- The KI narrow-leaved mallee woodland may have been more productive in the past.

Question 19. How many images have animals that cannot be classified?

KI LfW have around 50 images that they currently cannot classify but they are confident they have correctly identified the animals in the majority of images.

1.5 Summary

Detection of the KI dunnart remains an issue and makes it hard to gain an understanding of demographics and life history. However, the KI dunnart appears to be in very low densities in the habitat it remains in.

R Hohnen's monitoring has given scientists more confidence in understanding the range and distribution of the KI dunnart.

Hopefully future tools and improved technologies will enable changes to the KI dunnart population to be cost-effectively monitored over time.

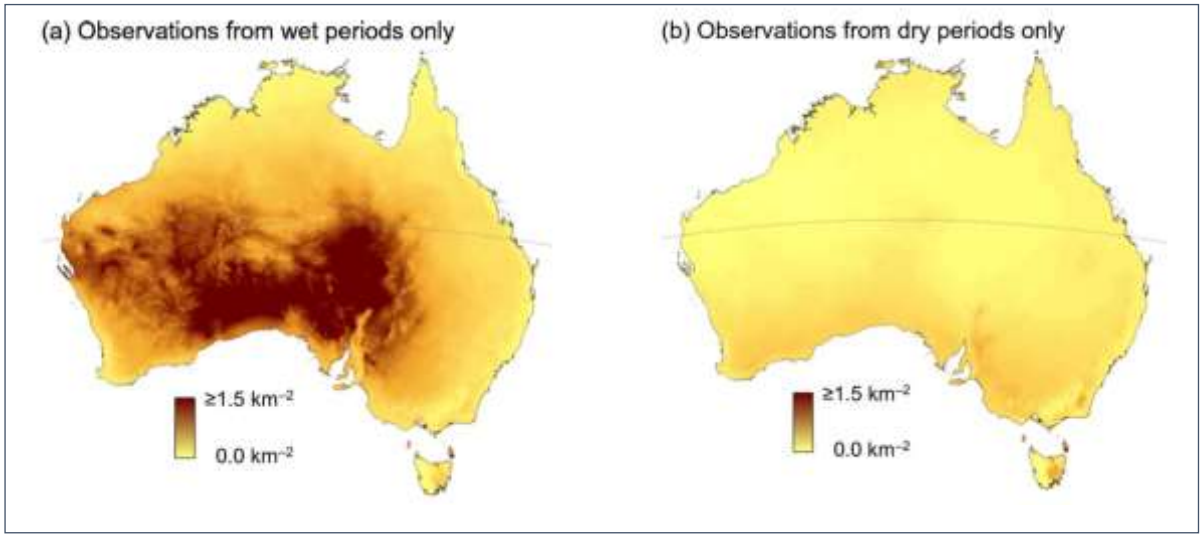
2. Threats

2.1 Feral cat densities on Kangaroo Island

(Dr Rosemary Hohnen, National Environmental Science Program)

There are between 2–6 million feral cats in Australia.

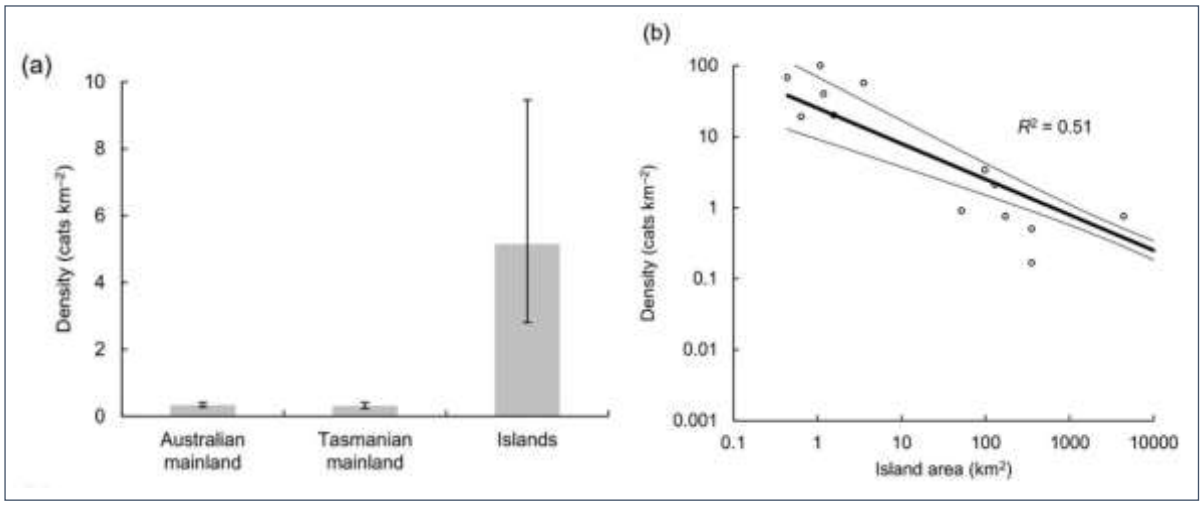
Figure 18. Enumerating a continental-scale threat: How many feral cats are in Australia? (Legge, S., et al. 2017 *Biological Conservation*, 206)



Variation between the mainland and islands

Feral cat densities vary between mainland Australia and off-shore islands, particularly small islands, where densities of up to six cats per square hectare have been recorded. These differences are driven by food availability (see Figure 19).

Figure 19. Average feral cat density estimate (Legge, S., et al. 2017 *Biological Conservation*, 206)



Feral cat density on Kangaroo Island – research questions

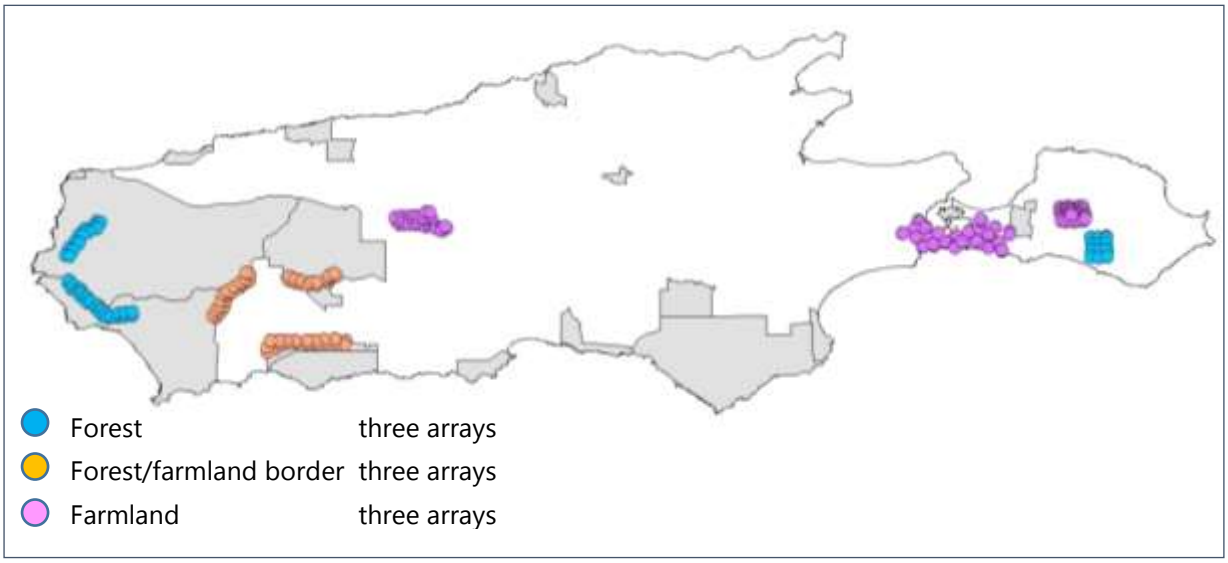
1. How do feral cat densities on Kangaroo Island compare to mainland estimates?
2. How does feral cat density vary across Kangaroo Island?
    - Forest
    - Farmland
    - Forest/farmland borders

Estimating density

Established motion triggered camera arrays in three different habitat types across Kangaroo Island (see Figure 20).

- Cameras positioned approximately 800 m apart.
- Cameras in situ for 1.5–2 months.
- Spatially explicit capture mark recapture through identifying the different pelage of individual cats.

Figure 20. Location of camera arrays across Kangaroo Island

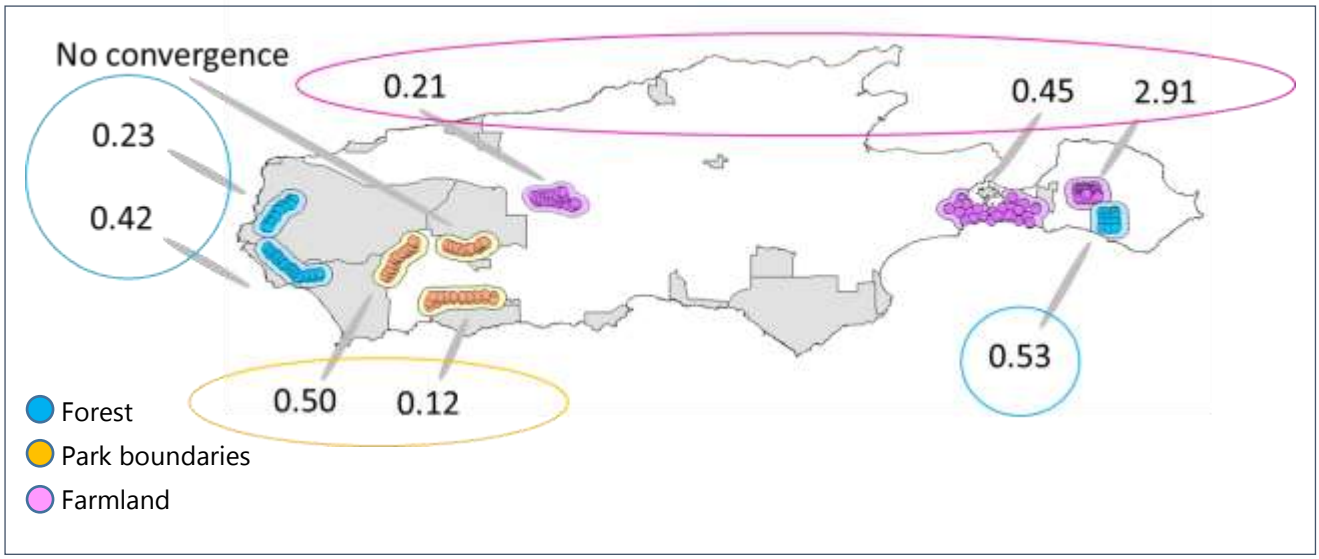


Feral cat density results

Feral cat densities vary considerably geographically across KI and across different habitat/land use types (see Figure 21).

- Farmland was very variable, from 0.23 to 2.91. Densities were especially high near carcass dumps and after wildlife culls and were similar to densities found around rubbish dumps in other areas in Australia.
- The average density across Kangaroo Island was 0.67 cats per hectare, which is between two and three times greater than the mainland, but is comparable with the densities found on other off-shore islands.
- Density likely to be determined by the availability of prey availability and the extent of cat control in the area.
- The density on Kangaroo Island may be so high because of the large amount of carcasses in the landscape, including deceased livestock on farms, culled wildlife and animals killed on the road.
- Wildlife are more likely to be at risk of predation from feral cats in high density areas.

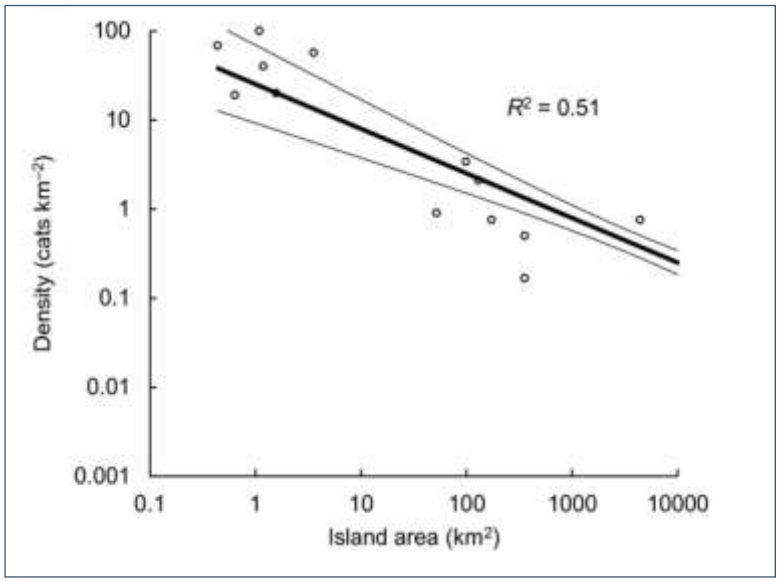
Figure 21. Variability of feral cat densities across Kangaroo Island



Does this fit with other Australian islands?

- Average density: 0.67 cats/km^2
- Average density without outlier: 0.35 cats/km^2
- Island area: 4,405 km^2 (see Figure 22)

Figure 22. Relationship between feral cat density and island area
(Legge, S., et al. 2017 *Enumerating a continental-scale threat: How many feral cats are in Australia?* Biological Conservation, 206



Outcomes

Cat densities vary across KI with:

- Farmland
- Forest
- Forest/farmland boundaries

Likely a result of factors other than broad vegetation type:

- Prey density
- Availability of roadkill/carcasses
- Shooting

Cat densities are on average higher than mainland estimates:

- Likely threaten wildlife, particularly in high density areas.

2.2 Fire and the KI dunnart

(Dr Rosemary Hohnen, National Environmental Science Program)

Fire is intrinsic to Australia landscape. Australian wildlife has species specific preferences for different fire-aged habitat.

- Following a fire vegetation changes from low density to a high density (approximately one to two years post-fire) and then back to a lower density (approximately six years post-fire).
- The abundance of some dunnart species peak six to nine years post-fire, while others peak nine to sixteen years post-fire.

Research questions

1. What are the fire history preferences of the KI dunnart?
2. How can we manage fire to help the KI dunnart survive in the landscape?

Fire history preferences of the KI dunnart

Trapping occurred at 42 sites across KI based on the locations where KI dunnarts have been previously trapped since 1967. Vegetation was classified by fire history. (See Figure 23).

Figure 23. Fire history preferences of the KI dunnart

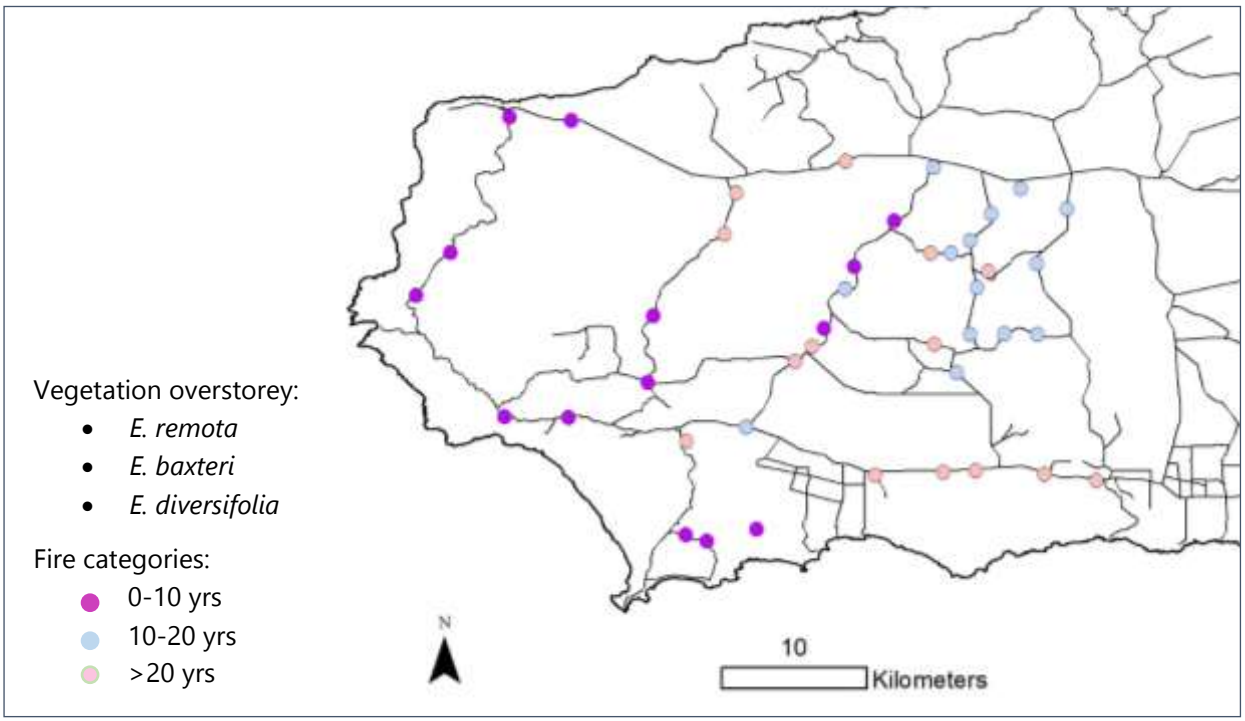
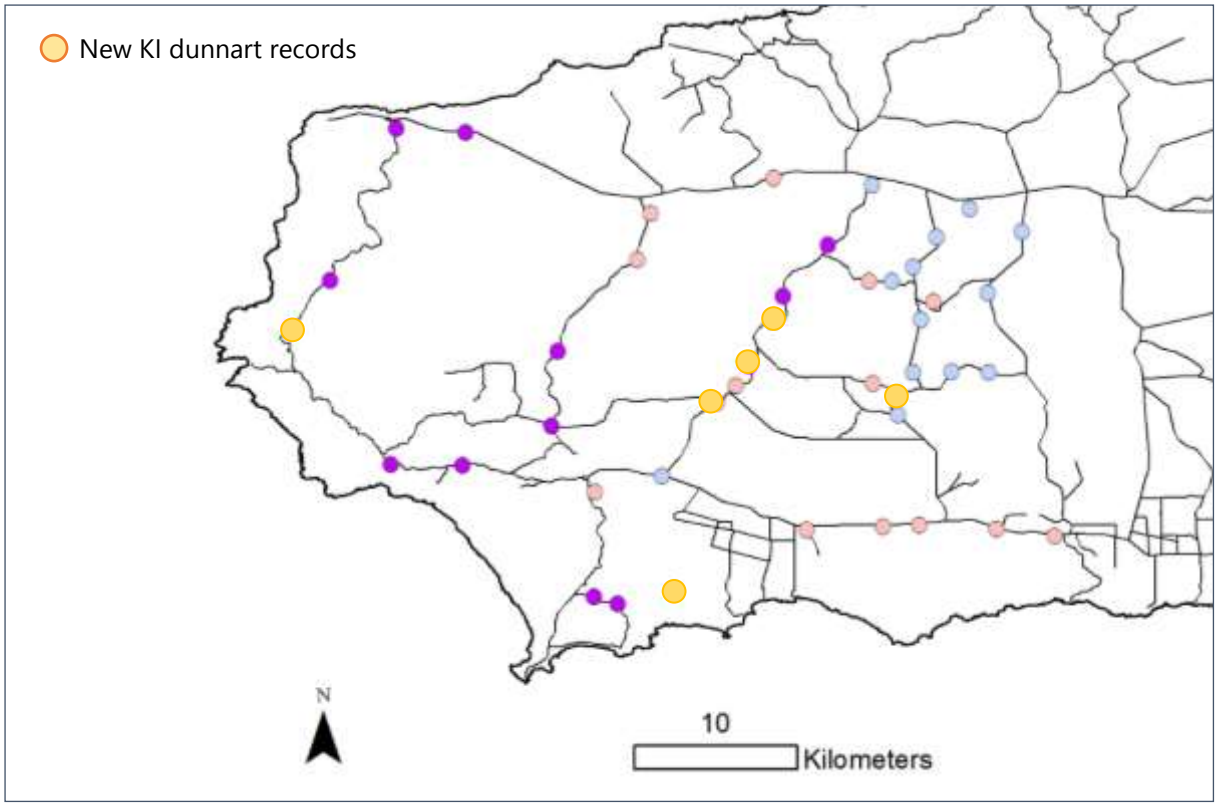


Figure 24. New KI dunnart records

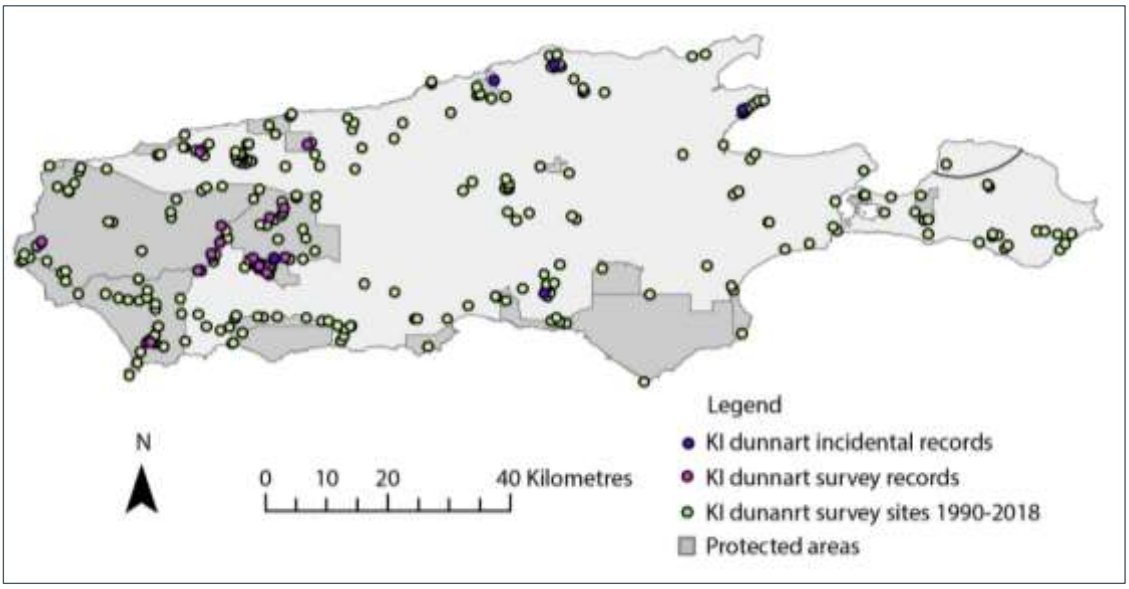


All KI dunnarts except one were detected in native vegetation 0–10 years post-fire. One KI dunnart was found in long unburnt native vegetation.

Species distribution models

- 17 detection and 174 non-detection survey records used (see Figure 25).
- All surveys were conducted from 1967–2018.

Figure 25. Survey records for KI dunnarts



Species distribution models help identify the environmental variables that are correlated with the distribution of the species. Using these environmental variables, a predicted distribution of the species can be mapped (see Figure 26). The models are good for:

- predicting areas where a species might occur
- identifying what habitat features drive the distribution of a species
- identifying where/what management actions might be most effective.

Figure 26. Spatial distribution model

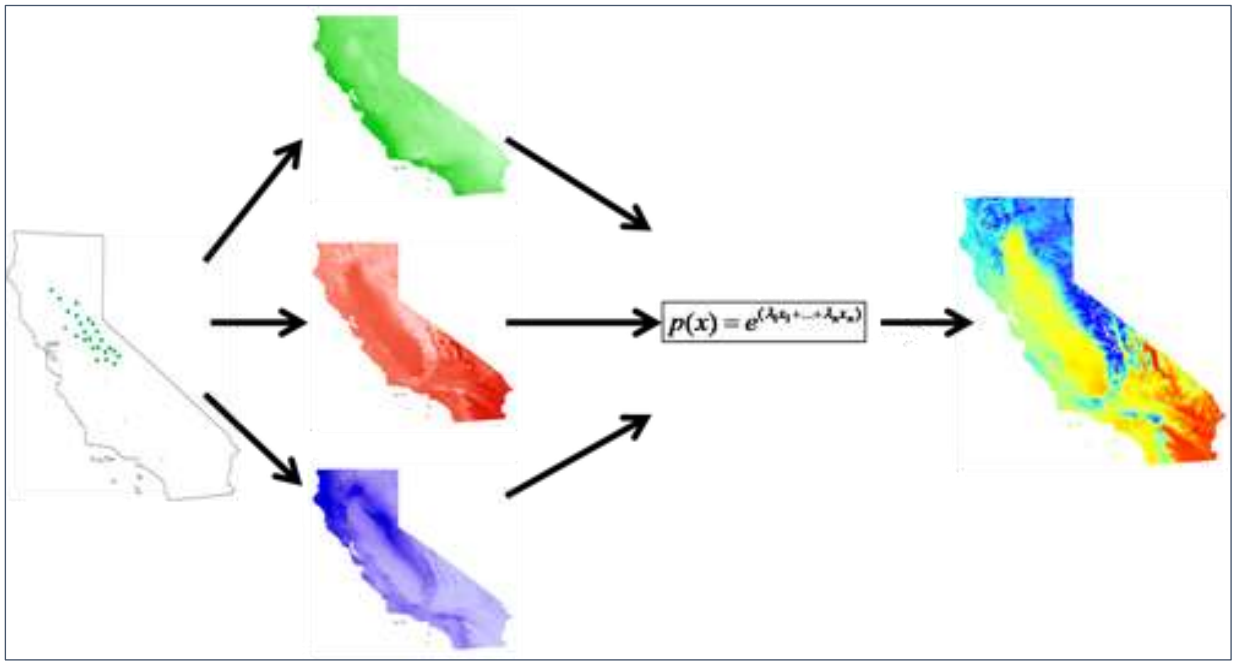


Figure 27. Environmental variables

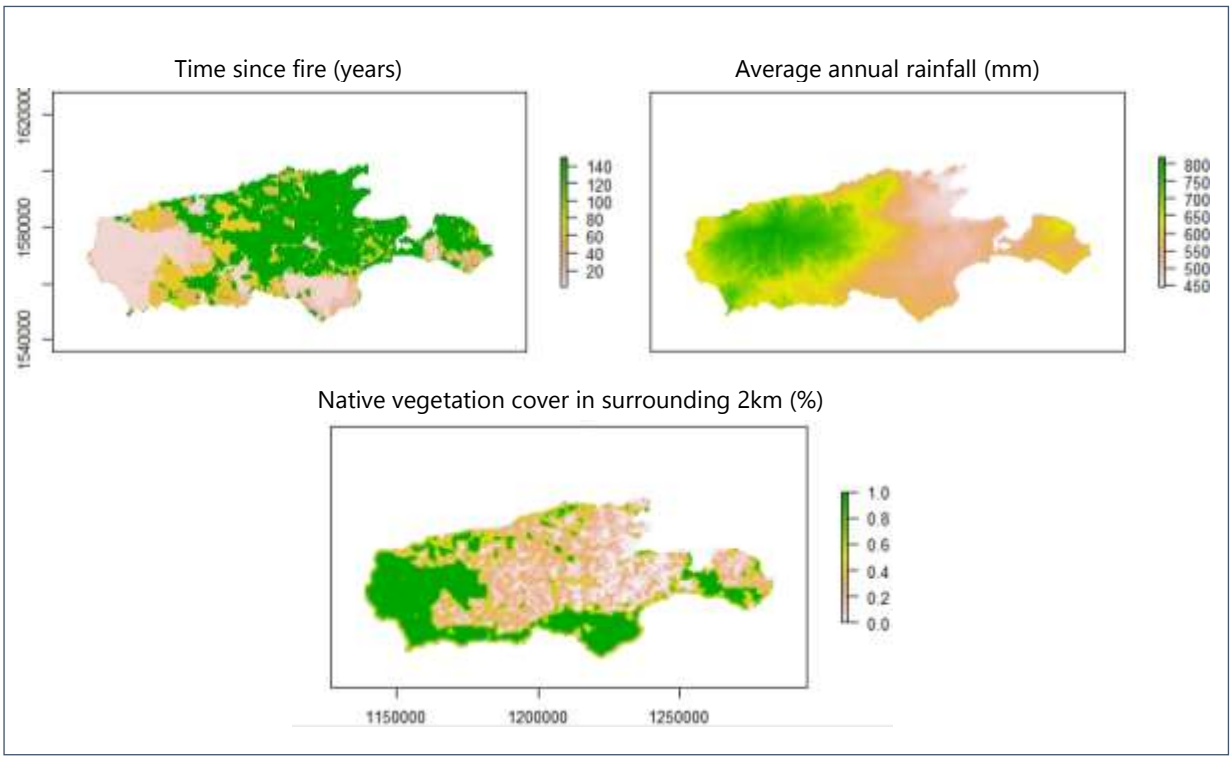
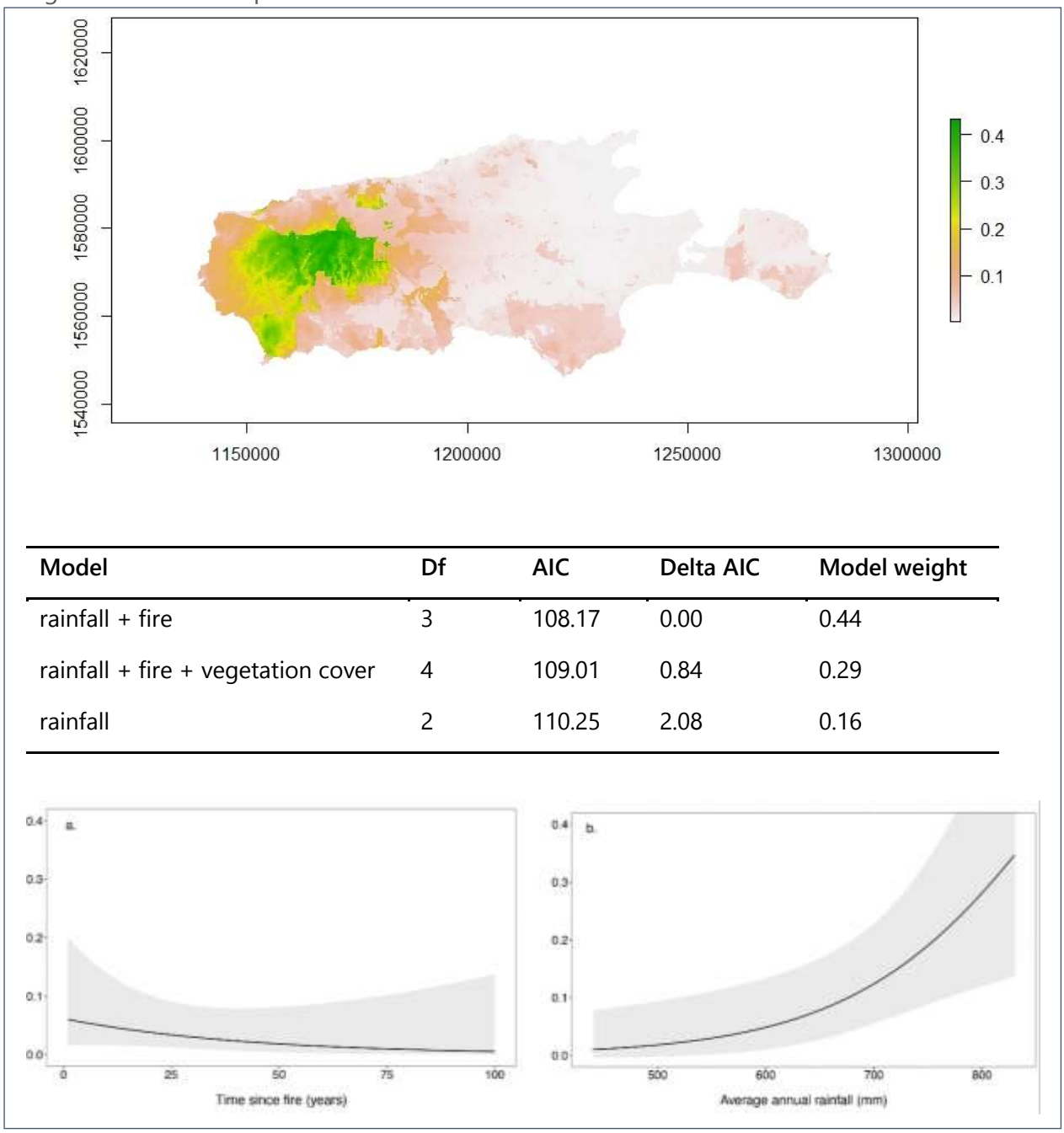


Figure 28. Model output



Model	Df	AIC	Delta AIC	Model weight
rainfall + fire	3	108.17	0.00	0.44
rainfall + fire + vegetation cover	4	109.01	0.84	0.29
rainfall	2	110.25	2.08	0.16

Variable importance:

- Rainfall: 0.98 Fire: 0.75 Cover: 0.39

Selection for:

- High rainfall areas >700 mm
- Younger vegetation age classes (0–20 years post-fire)

The model found rainfall and time since fire were the best predictors of KI dunnart distribution.

- The greatest number of KI dunnarts were found in habitat which receives over 700 mm of rainfall per year and is between 0–20 years post-fire.

Management outcomes

As vegetation ages, increase availability of 0–20 years post-fire

- Small scale
- Low intensity
- In high rainfall areas

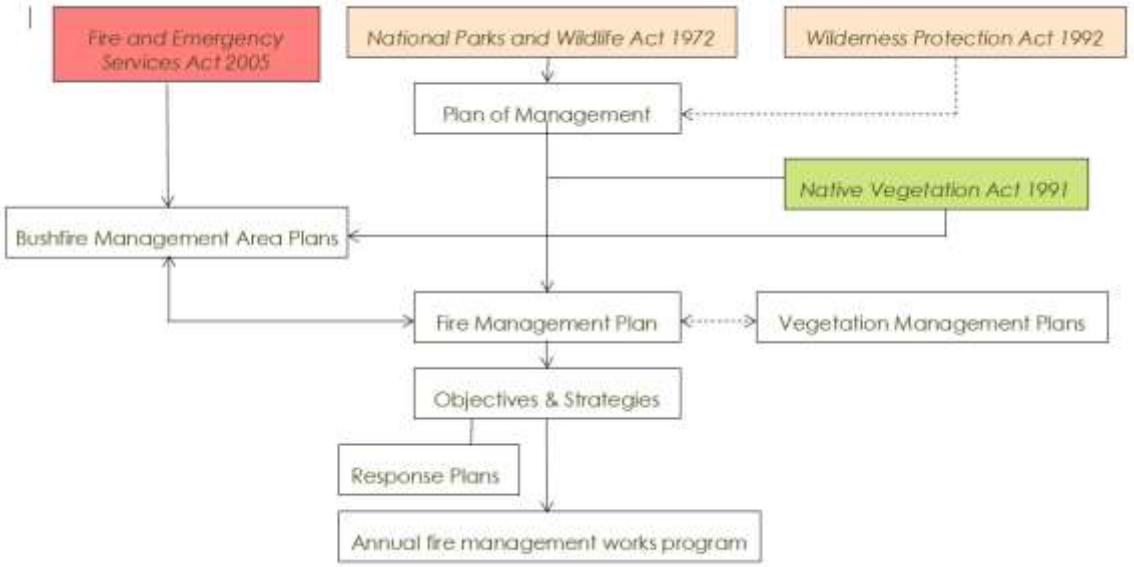
May help prevent broadscale wildfire (e.g. December 2007)

- Increase vegetation age diversity.
- Small scale burns every 15–40 years could benefit KI dunnarts and would increase the diversity of age classes within Flinders Chase National Park.
- Low intensity burns are generally more beneficial for small mammals. Feral cats often target fire scars for food.

2.3 Fire planning around ecology on KI

(Anne McLean, Department for Environment and Water, Government of SA)

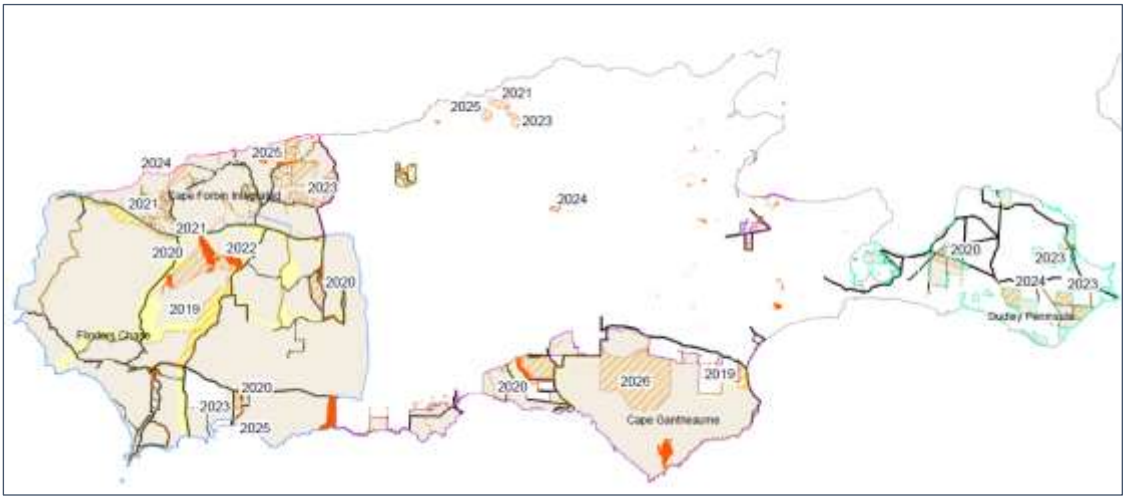
DEW Planning framework



Planning approach

- Regional or landscape scale through the development and delivery of strategies in a fire management plan for a landscape or group of reserves.
- Operation or site specific scale through the development and delivery of a prescribed burn or other on ground works.

Figure 29. KI proposed five year burn program



Fire Management Plans

Fire management plans help to guide fire management activities in high fire risk areas across South Australia.

A plan aims to assess the level of risk of a bushfire, identify objectives for fire management, and outline strategies and propose works to increase the level of bushfire preparedness within the area outlined in the plan.

Adopted fire management plans apply for up to 10 years unless they are required to be reviewed due to a major fire, a change in policy, objectives or management direction, or on-ground works.

Ecological Fire Management Guidelines

The management of fire to maintain biodiversity is achieved through the Ecological Fire Management Guidelines (see Figure 30). It is based on accumulating knowledge of species, populations and communities and their response to fire regimes, and then applying this knowledge to fire management practices to maximise biodiversity outcomes.

- Defines fire regimes for fire-prone vegetation types. It is based on accumulating knowledge of species, populations and communities and their response to fire regimes, and then applying this knowledge to fire management practices to maximise biodiversity outcomes.
- Based on species most vulnerable to changes in fire regime elements (Key Fire Response Species).
- Limit of species tolerance called 'Thresholds of Potential Concern'.

Figure 30. Ecological Fire Management Guidelines

		ECOLOGICAL FIRE REGIME							
		Interval		Spatial Criteria		Frequency	Intensity		Season
MVS No	MVS NAME	TPC1: Lower threshold in years	TPC2: Upper threshold in years	Inter-fire intervals within TPC1 & TPC2 across more than X% of the extent of this MVS within the planning area	Percentage of the MVS to stay > TPC2	Avoid more than 2 fires within a period of X years	Avoid more than 2 successive fires of low intensity (Yes/No)	Some medium to high intensity fire needed to regenerate some species (Yes/No)	Avoid more than 1 successive fires in season
4	Eucalyptus forests with a shrubby understorey	20	50	40	30	40	Y	Y	Spring or during & following drought
5	Eucalyptus forests with a grassy understorey	5	50	40	30	30	N	N	Spring or during & following drought
8	Eucalyptus woodlands with a shrubby understorey	20	50	40	30	40	Y	Y	Spring or during & following drought
9	Eucalyptus woodlands with a grassy understorey	5	50	40	30	30	Y	Y	Spring or during & following drought
12	Callitris forests and woodlands	15	60	40	30	70	Y	Y	During & following drought

Ecological strategies and guidelines

Through the risk assessment species which are vulnerable to fire management can be identified and ecological fire management strategies developed to improve biodiversity outcomes. The document is referred to as the primary source of information for appropriate management actions when undertaking fire management activities in the vulnerable species habitat.

- Ecological fire management strategies exist for several significant threatened or pest species for which fire is a critical threat or management tool.
- Objective of strategies is to develop a consistent approach to ecological fire management for significant species.
- Developed using the same risk assessment methodology used in DEWs fire management planning.

Ecological fire management strategies

- Basic species information.
- Risks posed by inappropriate fire regimes.
- Fire management objectives and strategies.
- Actions to mitigate the assessed risk.

Strategies for fire management in KI dunnart areas

- Ensure bushfire risk mitigation and suppression activities consider prevention of population or habitat loss due to fire.
- Reducing fuel at strategic locations to minimise the extent of a bushfire burning an entire patch of suitable habitat.
- Ensure occupied habitat is not deliberately burnt without appropriate KI dunnart-specific management considerations.
- Promoting a habitat mosaic consisting of a range of post-fire age-classes.
- Monitor the fire response of KI dunnarts to changes in seral stages of habitat.

Environmental assessment pre burn

All prescribed burn plans and other significant works must undergo an environmental assessment process.

- assesses the ecology of the area within the defined assessment boundary
- Biological Database of South Australia (BDBSA)
- ramble survey
- fuel hazards
- prescriptions.

Fire Information Management System (FIMS)

- habitat
- response to fire
- indicator species
- mitigating actions
- fire tracks and trails
- minor works.

Figure 31. Fire Information Management System

Monitoring

The minimum monitoring requirements for prescribed burns are:

- pre and post burn fuel hazard
- reporting of burn results (burn outcome, fuel hazard, fire behaviour, outcome of environmental assessment issues and completion of follow-up works)
- monitoring of key issues identified in the environmental assessment (e.g. threatened species, weed regeneration)
- mapping area burnt and where possible, burn severity.

Integrating Natural Values into Bushfire Suppression

Natural Values Team Officers are Incident Management Team (IMT) trained ecologists, deployed as technical specialists.

Mount Taylor Conservation Park example

During the fire:

- IMT contacted DEW for natural values support
- recovery plan written.

Post Fire:

- camera traps installed
- monthly photographic monitoring for six months
- post fire ramble six months post fire
- post fire ramble one year after initial ramble.

Challenges

- outdated fire management plan
- one age class of vegetation
- threatened species
- community expectations versus reality
- budget constraints
- continuity of knowledge
- knowledge gaps and missing data.

2.4 Discussion of additional threats

Fire is very important to promote biodiversity, protect assets and manage land. In recent years the highly fragmented KI narrow-leaved mallee woodland has rarely been burnt.

How do the threats interact – feral cats and fire, fragmentation and fire? Can the threats be managed as a whole?

Full risk assessments are needed for all threats:

1. **Fire**

- How up to date is the DEW Biological Database of South Australia and GIS layers that identify significant KI dunnart habitat?
- Wildfires that create large areas of native vegetation with one age class are a high risk to threatened species, in particular the KI dunnart.
- Ramble surveys can be tailored for certain species, but they are limited by budget restraints. Links are being made between pre and post burn activities.
- Keep prescribed burns away from known KI dunnart habitat.
- Use prescribed burns to create a mosaic of vegetation with different age classes.

2. ***Phytophthora cinnamomi***

- Pc leads to loss of a habitat and potentially opens the vegetation creating easy pathways for predators. Feral pigs are potential vectors for moving Pc through the landscape.
- During fire incidents and prescribed burns, all vehicles attending the fire are treated for Pc before and after the fire. Both DEW and the KI Council have Pc hygiene trailers which are used during fires and prescribed burns. KI Land for Wildlife have recently purchased a Pc hygiene trailer for use by members to treat Pc on their properties.
- KI Land for Wildlife are working with students to use drones to map Pc. There are plans for this to become a regular activity for year 12 technology students at Seton High School.
- Pc needs to be mapped across KI to determine the scale of the issue. Much of DEW data relating to Pc is old and needs to be updated to identify Pc in public lands.
- Information relating to Pc effected areas held by KI Land for Wildlife could be linked with the DEW fire history database.

3. **Native predators**

- Native predators, such as snakes and goannas, may be preying on the KI dunnart. Re-introducing medium-sized native carnivores to KI, such as the quoll, may reduce this predation, or may compete with the existing predators.
- Camera trapping data could give good information about predator/prey interactions for the KI dunnart.
- Predator control activities need to focus on introduced species first.

4. **Introduced predators**

- The Natural Resources KI biosecurity program is working to prevent the introduction of invasive species on KI, such as the rabbit and fox.

- There is a large food source for feral cats on KI due to the death of wildlife on roads, wildlife culling undertaken by farmers and livestock deaths.
  - » Farmers cannot move culled wildlife carcasses and are not required to bury or destroy them.
  - » These carcasses can be used to attract feral cats to an area for control, e.g. via trapping.
- Need to review the data we currently have on feral cat movements and activity to determine their temporal predation habits. Past research suggests they are opportunistic and are active during the day and night, moving to where prey is.
  - » KI dunnarts are susceptible to predation both at night when they're active and during the day when they are asleep.
- The content of feral cat stomachs have been analysed for the past two years through the KI Feral Cat Eradication Program but no KI dunnarts have been detected. KI Land for Wildlife are continuing to analyse the stomach contents of any feral cats they control.
- Current 1080 baits used for feral cats are toxic to KI dunnarts, so any baiting program has the potential to adversely impact on the KI dunnart.

5. Climate change

Climate change is reducing the rainfall on Kangaroo Island and causing warmer temperatures. Potential impacts to the KI dunnart include:

- loss of habitat through changing vegetation structures
- increased prevalence of wildfires
- changing food sources due to impacts to invertebrate populations
- increased spread of Pc altering habitat.

6. Habitat loss and fragmentation

Increased infrastructure across KI, such as new fire breaks and walking trails with associated infrastructure, is creating tracks through previously intact native vegetation. This could be impacting on the KI dunnart through:

- loss of habitat during construction of the track
- increased pathways for weed spread, compromising habitat
- increased predation from feral cats through their use of the tracks to move more easily through native vegetation.

7. Native competitors

Other native species may be competing with the KI dunnart for their food, limiting their population growth.

8. Disease

- Toxoplasmosis is present on Kangaroo Island and is spread by feral cats. Other species of dunnarts and Dasyurid species found throughout Australia are susceptible to toxoplasmosis.
- The small population size of KI dunnarts makes them particularly susceptible to diseases.

9. Harvesting plantation timber

- Plantation timber is planned to be harvested and exported from Kangaroo Island over the next few years.
- This will create a high volume of heavy vehicle traffic through KI dunnart habitat and has the potential to reduce their numbers through road deaths.
- Removing plantations will result in large numbers of native animals moving from plantations into native vegetation. These animals may compete with the KI dunnart for food and/or predate on them.

Question 1. How confident are DEW that they can detect KI dunnarts pre and post fires with their surveys? Are remote cameras used in their monitoring?

- Ramble surveys are generally undertaken for flora not fauna so cameras are not used.
- These surveys need to be comprehensive enough and of a sufficient timeframe, to ensure false negatives are limited.
- If conducted for fauna also, these surveys could assist in developing an understanding of good KI dunnart habitat.

Question 2. What is good KI dunnart habitat?

The preferred vegetation structure of KI dunnart habitat is unknown and needs to be defined.

Question 3. Are KI dunnarts nutritionally limited?

- Need to know what the KI dunnarts food source is and where it is located. The food source needs to be monitored to determine its status.
- A similar sub-species from the Eyre Peninsula and Western Australia (*Sminthopsis dolichura*) could be compared to the KI dunnart to gain a better understanding of the KI dunnarts habitat preferences and food resources.

Question 4. How big a threat is Pc to KI dunnarts?

While monitoring private land on western KI, Land for Wildlife has seen large areas of potential damage to native vegetation from Pc. However, the scale of this is unknown and the future risk of Pc to KI dunnart habitat is also unknown.

Question 5. How good is the data being used by DEW for prescribed burning?

- Local GIS layers have identified regionally important habitat.
- The Biological Database of South Australia contains information from DEW surveys and opportunistic sightings by DEW staff.
- When developing plans, experts are consulted.
- An on-line assessment tool is currently being developed that will use experts to validate the information it reports.

3. Conservation actions

3.1 Feasibility of broadscale feral cat baiting on western KI

(*Dr Rosemary Hohnen, National Environmental Science Program*)

Feral cats are known threats to Kangaroo Island biodiversity.

Four control options are currently available for feral cat control:

1. grooming traps
2. shooting
3. baiting
4. cage traps.

To undertake control by shooting and with grooming and cage traps, activities need to be close to the road and in line of sight.

Three feral cat baits have been developed. Eradicat is commercially available but the other two are still in development.

- Eradicat is a 1080 based bait.
- 1080 naturally occurs in plants from the genus *Gastrolobium*.
- This genus is found through Western Australia and to a much smaller extent in South Australia, New South Wales and Victoria.
- In WA animals have evolved to tolerate 1080, but in other states this tolerance is not as strong.

Small mammal tolerance to 1080

Common name	Average adult body weight (kg)	LD50 (mg kg^{-1})	Weight of bait for LD50 (g)	Number of baits for LD50	Reference
Australian raven	0.6	5.1	9.9	0.7	McIlroy et al. 1984
Common brush-tailed possum	2.6	0.9	7.5	0.5	McIlroy et al. 1982
Bush rat	0.1	1.8	0.5	<0.1	Twigg et al. 2003
Cat	4.2	0.3	5.6	0.4	Eason et al. 1992
House mouse	0	8.3	0.4	<0.1	Twigg and King 1991
Rosenberg's goanna	0.7	40	93	6.2	Twigg and King 1991
Southern brown bandicoot	0.8	7	19	1.2	Twigg and King 1991
Tammar wallaby	6	0.2	3	0.2	Oliver et al. 1979
Western grey kangaroo	30	20	2000	133	Oliver et al. 1979
Fat-tailed dunnart	0	2.1	6.9	0.1	Calver et al. 1989
Striped-faced dunnart	0	1.0	3.3	0.1	Twigg and King 1991

Research question

What proportion of non-target species populations will consume baits?

Non-toxic feral cat bait trial

- Non-toxic Rhodamine B baits were distributed in a grid pattern in August and November at four sites in Flinders Chase National Park (see Figures 31 and 32).
- After three weeks animals were trapped using Elliot and pitfall traps. Their whiskers were sampled and examined for traces of Rhodamine B, which appears as a band.

Figure 31. Location of non-target bait trial

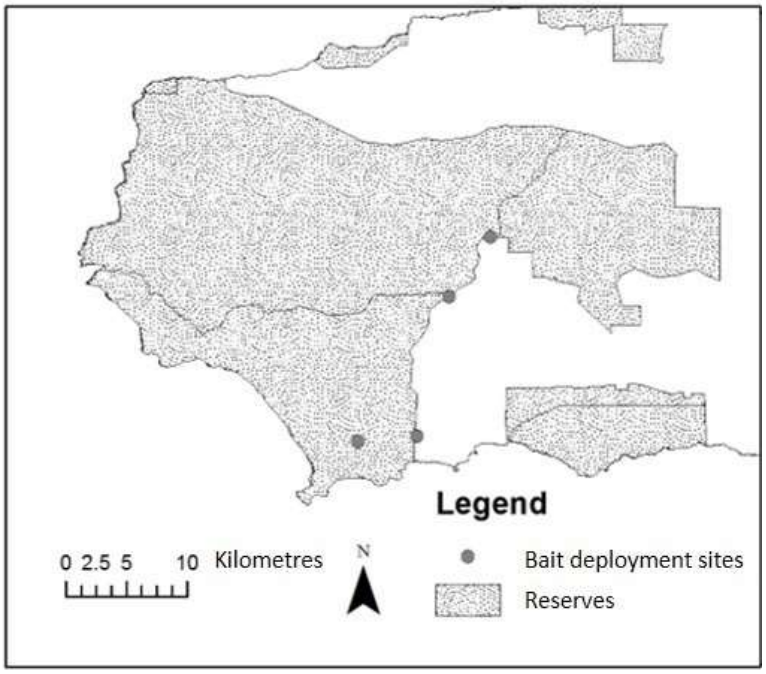
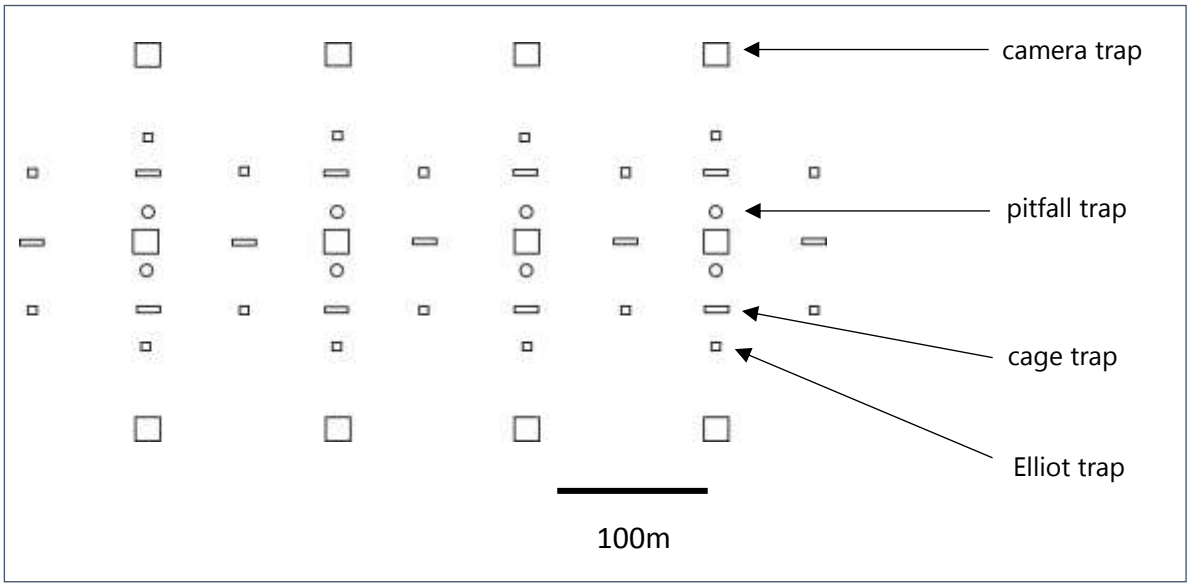


Figure 32. Design of non-target bait trial



Bait uptake on cameras

- The results showed non-target species were very interested in the baits and took almost all of the baits.
- 99% of the baits taken in August and 72% were recorded.
- 89% of the baits taken in November and 80% were recorded.
- Low encounter rate by feral cats (two in August and four in November).
- 60% of the baits were taken by bush rats, common brushtail possums and ravens.
- A KI dunnart was photographed at a bait once, but did not take the bait (see Figure 33).

	All rounds (%)	
Common name	**August**	**November**
Shy heathwren	-	-
Grey shrikethrush	-	-
Australian raven	11	18
Feral cat	<1	-
Southern brown bandicoot	-	1
Tammar wallaby	-	-
Western grey kangaroo	-	-
House mouse	2	1
Bush rat	38	20
Kangaroo Island dunnart	-	-
Short-beaked echidna	-	-
Common brushtail possum	20	38
Rosenberg's goanna	-	3
Unknown	29	19

Figure 33. KI dunnart at a non-toxic bait

Proportional bait consumption

Whisker samples

Common name	August			November		
	Without bands	Bands	Proportion with bands (%)	Without bands	Bands	Proportion with bands (%)
Western pygmy-possum	-	-	-	4	2	33
Little pygmy-possum	1	-	0	2	-	0
Southern brown bandicoot	-	-	-	1	-	0
House mouse	6	5	45	5	-	0
Bush rat	34	48	59	19	19	50
Common brush-tailed possum	-	18	100	2	10	83

Bait trial outcomes

High uptake by some non-target species:

- Common brush tailed possums
- Native bush rat

Low impacts on others:

- Tammar wallaby
- Western grey kangaroo

Unknown impacts of baiting on:

- KI dunnart
- Southern brown bandicoot

Other baits still being developed are likely to be more appropriate:

- Hisstory (1080 in hard capsule surround by meat)
- Curiosity

Question: If baiting occurred in winter could hibernating species such as goannas and pygmy possums be missed?

3.2 Update from the KI Cat Management Program

(Mike Greig, Department for Environment and Water Government of SA)

Feral cat eradication and domestic cat management are complex matters that require social, economic and environmental considerations. There are many drivers for feral cat eradication including the protection of threatened species and reducing the impacts of diseases on KI agricultural industries (toxoplasmosis and sarcosporidiosis).

The KI NRM Board has already successfully worked with the Kangaroo Island community to eradicate feral goats and deer from the island.

To be successful eradication programs need to be long-term, properly resourced and involve many people.

The KI feral cat eradication program has three phases (see Figure 34):

Figure 34. Three stages of KI Feral cat eradication program

Phase 1: Trial feral cat control techniques, establish baseline monitoring programs and establish a process for gradual phasing out of all cat ownership

- Trialled a variety of traditional and innovative cat control techniques to assess their effectiveness for Phase 2 on the Dudley Peninsula isthmus, e.g. cage trapping, non-toxic baits, lures, detector dogs and Felixer™ grooming traps.
- Determined feral cat abundance, movements and home ranges to guide the development of the eradication plan for Phase 2 (see Figure 35).

- Collected baseline data on native fauna to be used to measure whether cat removal increases native fauna populations (see Figure 36).
- Collected baseline data on rodent numbers to be used to measure whether cat removal leads to mouse or rat plagues.
- Will construct a feral cat-proof fence across Dudley Peninsula isthmus to prevent the movement of feral cats from western Kangaroo Island to the Dudley Peninsula following their eradication there.
  - » The fence has been designed, materials sourced and a non-government organisation is ready to supply the labour to build it. Construction is due to begin in August.
  - » Negotiations continue with effected landholders and the KI Council regarding land tenure, permissions and maintenance.
  - » Discussions are continuing with the Department of Planning, Transport and Infrastructure to determine the best method to use across the Hog Bay Road.
  - » Once built, the fence will be monitored for efficacy and to ensure it is not adversely impacting native species.

Figure 35. Feral cat home ranges on the Dudley Peninsula isthmus

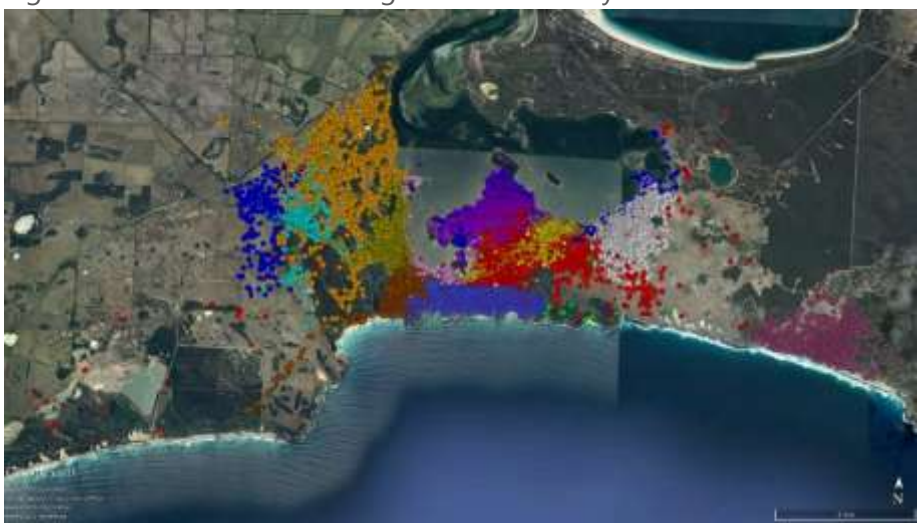
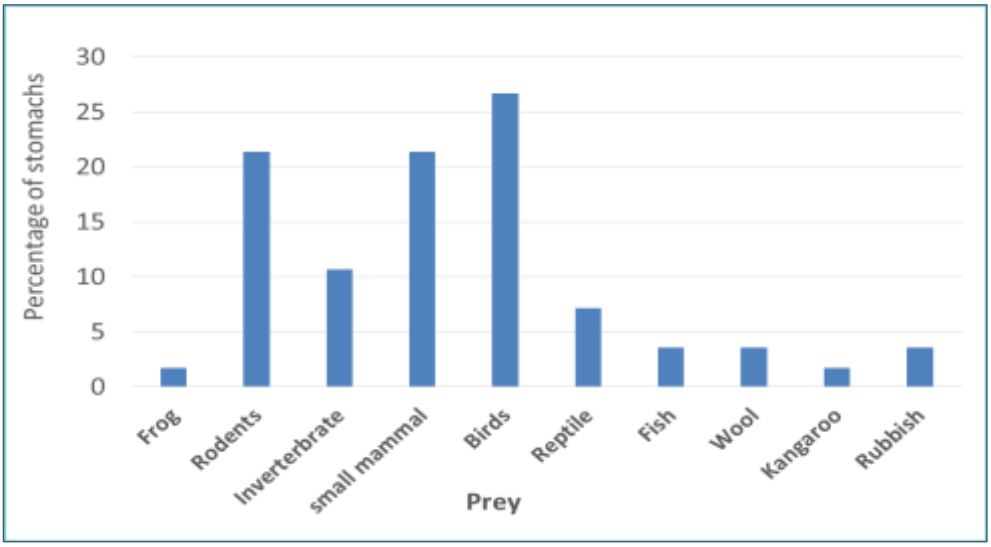


Figure 36. Results of analysis of feral cat stomachs



Phase 2: Eradicate feral cats from the Dudley Peninsula and monitor success of control actions

- Trials of the Felixer™ grooming trap in toxic mode on private property have been conducted to familiarise landholders with the functioning of the trap. The trial has been successful in specific areas when the traps are combined with other control measures. There has been limited non-target species. Trial results can be found at this link: https://www.naturalresources.sa.gov.au/files/sharedassets/kangaroo_island/plants_and_animals/pest_animals/feral_cat/preliminary_findings_of_the_felixer_grooming_traps.pdf

  This project, *Felixers versus Felis: Innovative engagement of Kangaroo Island landholders in feral cat control activities*, is supported by the KI NRM Board, through funding from the Australian Government's National Landcare Program Threatened Species Recovery Fund. The project is funded from January 2018 to June 2019.

- Training local landholders and their dogs to be feral cat detection teams to assist with feral cat control. An accredited interstate dog trainer will deliver field training and classroom sessions beginning in June 2019. This project, *Feral Cat Strike Force —- developing an innovative, best practice, community wildlife detection dog program for feral cat eradication on Kangaroo Island to increase livestock farming profitability and protect island biodiversity*, is supported by the KI NRM Board, through funding from the Australian Government's National Landcare Program Smart Farms Small Grants Fund. The project is funded from October 2018 to April 2020.

- Eradication of feral cats from the Dudley Peninsula. This project, *Creating a safe haven for the Kangaroo Island dunnart and other priority threatened species by eradicating feral cats from the Dudley Peninsula*, is just beginning and is supported by the KI NRM Board, through funding from the Australian Government's National Landcare Program Regional Land Partnerships Program. The project is funded from April 2019 to June 2023.

Phase 3: Eradicate feral cats from Kangaroo Island and monitor success of control actions
To begin when feral cats have been eradicated from the Dudley Peninsula.

Investigations by Pat Taggart from the University of Adelaide has shown the levels of sarcosporidiosis in Kangaroo Island sheep are much higher than on mainland Australia.

Question 1. Is eradication of feral cats on the Dudley Peninsula the key to eradication for the whole island?
Beginning eradication on the Dudley Peninsula will enable techniques to be refined so the control team can learn by doing and indicate if success across all of KI is possible.

Question 2. How will you deal with cats repopulating the Dudley Peninsula from domestic cat escapees?
Are cognisant of this issue and have been working closely with the KI Council to implement effective domestic cat management on KI. The KI Council has good domestic cat management in place with strong by-laws. Effective feral cat control and domestic cat management at Penneshaw will be the key to success.

3.3 Private land management for dunnarts

(Pat Hodgens and Heidi Groffen, Kangaroo Island Land for Wildlife)

The KI Land for Wildlife program is a voluntary property registration scheme for landowners who wish to manage areas for biodiversity and wildlife habitat.

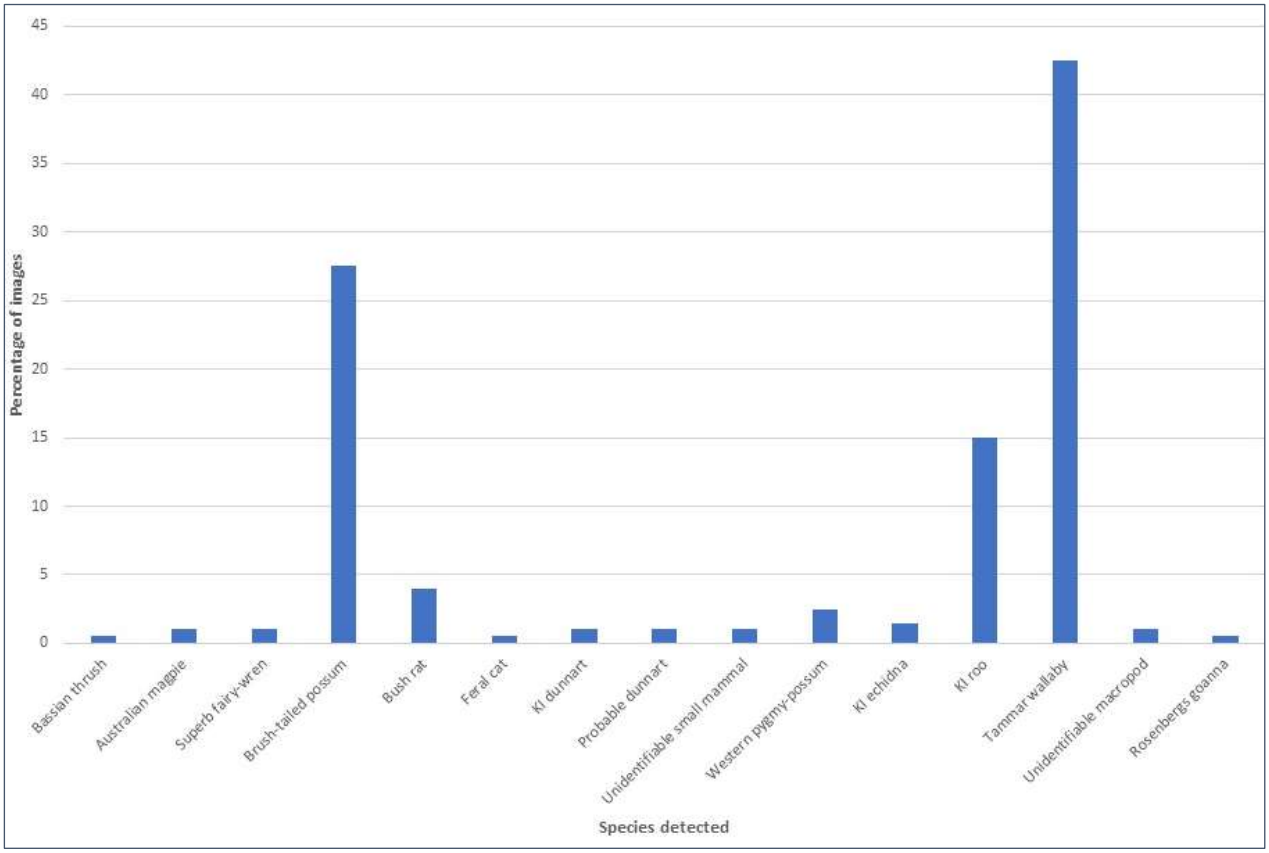
- The program was established in 1981 by the Victorian Government and Birdlife Australia.
- Programs are now found across Victoria, New South Wales, Queensland, Northern Territory and New Zealand.
- The KI Land for Wildlife incorporated association is the first in South Australia.

Landholder engagement

To engage landholders Pat and Heidi meet them at their property and discuss their values and the threats to their values while walking around the property with them.

- Landholders generally want to identify the species on their property, the threats facing these species and actions they can undertake to assist them.
- Once the landholders join the association Pat and Heidi establish a remote camera array on their property to identify the species that are there. They assist landholders to monitor and review the data collected by the cameras. This gives landholders a better understanding of the species on their properties.
- Using the information from the camera trapping, Pat and Heidi develop a species lists for each property and then work with the landholders to help them develop strategies to help them mitigate threatening processes on their properties (see Figure 37).

Figure 37. Species detected on camera trap surveys in October 2018



Helping landholders manage feral cats

- Trapping surveys have recorded 120 feral cats across the 18 sites where Pat and Heidi are working on behalf of KI Land for Wildlife.
- Feral cat management has been targeted around sites where KI dunnarts have been recorded, with 62 feral cats controlled to date (see Figure 38). One landholder alone has removed ten feral cats.
- Pat and Heidi own two detector dogs which they will use to assist landholders to locate feral cats on their properties, particularly feral cats that are cage shy.
- KI Land for Wildlife will also invite Sporting Shooters' SA to undertake a targeted shoot for feral cats on their properties.
- The association has also purchased two Felixer™ grooming traps for feral cat control.

Figure 38. KI Land for Widlife KI dunnart management map

Helping landholders manage *Phytophthora cinnamomi (Pc)*

- Many of the properties owned by KI Land for Wildlife members appear to be effected by Pc. The association has recently purchased a Pc treatment trailer to help landholders treat Pc by spraying surrounding native vegetation with phosphite.
- Pat and Heidi also promote good Pc hygiene practises to landholders and provide them with wash down kits to prevent the spread of Pc from their boots and vehicles.
- KI Land for Wildlife are working with SA school students to map the spread of Pc across properties within their association.

While working with KI Land for Wildlife landholders, Pat and Heidi are increasingly finding evidence of feral pigs on their properties. They will invite Sporting Shooters' SA to undertake a targeted shoot for feral pigs on their landholder's properties.

Feasible solutions for conserving the KI dunnart on KI include:

1. Relocating a wild KI dunnart population to a zoo to establish an insurance population.
2. Translocating a wild KI dunnart population to another island to establish an insurance population.
3. Building a feral cat free exclosure fence around an existing population of KI dunnarts and managing known KI dunnart threats within the enclosure, e.g. other feral pigs and Pc.
    - » The fence would be permeable for KI dunnarts to allow them to come and go.
    - » Fire breaks would be established around the exclosure to protect it from wildfires.
    - » The fenced area could also conserve other threatened species, such as southern brown bandicoots, which could be translocated into it.
    - » The area could enable the enclosed population to be studied and may secure a population of wild KI dunnarts.
    - » If successful KI dunnarts could be translocated from this exclosure to the Dudley Peninsula once feral cats are eradicated from there.
    - » KI Land for Wildlife are currently developing a conservation action plan to outline the pros and cons of building an feral cat free exclosure for KI dunnarts on private land.

Community engagement is an essential part of KI Land for Wildlife's work. They currently have an active student program engaging local and off-island schools to help with conservation activities on their properties.

This work is dependent on funding from philanthropic organisations, government grants and landholders.

3.4 Discussion of management objectives and actions

The recovery objectives, actions, performance criteria and responsibilities outlined in the *Recovery Plan for the Kangaroo Island dunnart (Sminthopsis aitkeni) 2011* are still relevant. A method for reporting on these is required.

Long-term objectives:

(N.B. These objectives are just from one table, not a summary of all workshop delegates contributions)

- abate identified threats
- maintain and enhance known populations
- fill in knowledge gaps and manage/share knowledge
- improve community awareness and ability to act.

Site protection

- Protect and enhance habitat of existing/known KI dunnart populations.
- Identify and protect potential critical habitat for KI dunnarts from wildfire, Pc, feral cats and feral pigs.

Predators

- Quantify and mitigate predator impacts to KI dunnarts.
- Implement feral cat management (control/eradication) across the distribution of the KI dunnart in an experimental framework, whilst monitoring with camera traps to understand the size and interactive impacts of this potential threat.
- Quantify the impacts of feral cats on KI dunnarts and feral cat abundance.
- Explore the community's appetite for the non-target impacts of feral cat baits.
- Explore and manage the impacts of feral pigs on KI dunnarts.
- Determine predator use of fire scars.

Fire

- Determine the best fire structure for native vegetation to promote KI dunnarts.
- Implement fire management across the distribution of the KI dunnart in an experimental framework whilst monitoring with camera traps, to understand the size and interactive impacts of this potential threat.
- Fire is key. Create the right mix of age-class vegetation to promote KI dunnarts. Ensure there is a mix of age classes for native vegetation, unlike what currently exists in Flinders Chase National Park.
    - » Aim to create/maintain a fire mosaic at a landscape scale to produce a patchwork of different age class vegetation over the long term.
- Don't burn known KI dunnart sites just yet – establish fire breaks and prescribed burns to join up roads etc.
- Ensure subsequent local five year fire management plans contain a range of fire ages in potential KI dunnart habitat.
- Ensure KI dunnart data is available for fire planning.

***Phytophthora cinnamomi* (Pc)**

- Minimise the impact of Pc on KI dunnart habitat.
- Map the distribution of Pc to determine the known extent of Pc in KI dunnart potential habitat.
- Ensure Pc hygiene practises are used.
- Explore treatment options for Pc and their efficacy.
- Manage/treat Pc in potential KI dunnart habitat.
- Investigate feral pigs spreading Pc.

Restoration

- Improve habitat connectivity across KI.
- Restore potential KI dunnart habitat in higher productivity vegetation, e.g. KI narrow-leaved mallee woodland.

Community engagement

- Continue to work with the KI community to maintain their engagement in actions to conserve the KI dunnart.

Knowledge gaps

- Improve knowledge of, and monitor, KI dunnart ecology and map these parameters where possible, including:
  - » the population size of the KI dunnart and what limits its population size
  - » distribution and limits of distribution
  - » the quantified impact of threats to the KI dunnart (disease, Pc, overabundant herbivores, feral cats and feral pigs)
  - » reproduction
  - » temporal variability
  - » fate of individuals
  - » disease
  - » food limitations
  - » the thresholds of potential concern regarding the age classes of native vegetation.
- Explore whether existing conservation actions are still relevant/beneficial to the KI dunnart.
- Determine the size of a protected area that would be of most benefit to the KI dunnart.
- Design multi-purpose monitoring at the landscape level (i.e. bang for buck, systems level dynamics).
- Share data collected on KI dunnarts.

4. Summary, final comments and next steps

A revision of what is already known about the KI dunnart is required. This knowledge then needs to be considered creatively to develop actions that will enable the fate of the KI dunnart to be secured into the future.

- There is no evidence feral cats are impacting on KI dunnarts. The recent multiple records of the KI dunnart captured via remote cameras by KI Land for Wildlife gives an opportunity to further investigate KI dunnart requirements.
- Fire and feral cat management needs to be implemented across the landscape.
- The best bang for buck is to undertake multi-species monitoring to determine their population statistics.
- Restoring potential KI dunnart habitat in higher productivity vegetation on eastern Kangaroo Island could assist the KI dunnart to move into more habitats.
- The *Recovery Plan for the Kangaroo Island dunnart (Sminthopsis aitkeni*) 2011 recovery objectives, actions, performance criteria and responsibilities are still applicable today.
- There are still many key knowledge gaps that need to be researched to assist with the development/refinement of conservation actions for the KI dunnart.
- The work/knowledge of private landholders is very important and ensures that actions to conserve the KI dunnart will continue in the future, despite intermittent government funding.
- It would be good to accelerate the learning process required to conserve the KI dunnart.
- Expert advice is very important and will help guide the development of the conservation advice for the KI dunnart.
- A regime to monitor the performance/success/impacts of recovery actions is required.